ERSONAL COMPUTING JULY 1992 VOLUME 11 NUMBER 13 $2.95

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PC MAGAZINE

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First Look: Compaq's Low-Cost PCs

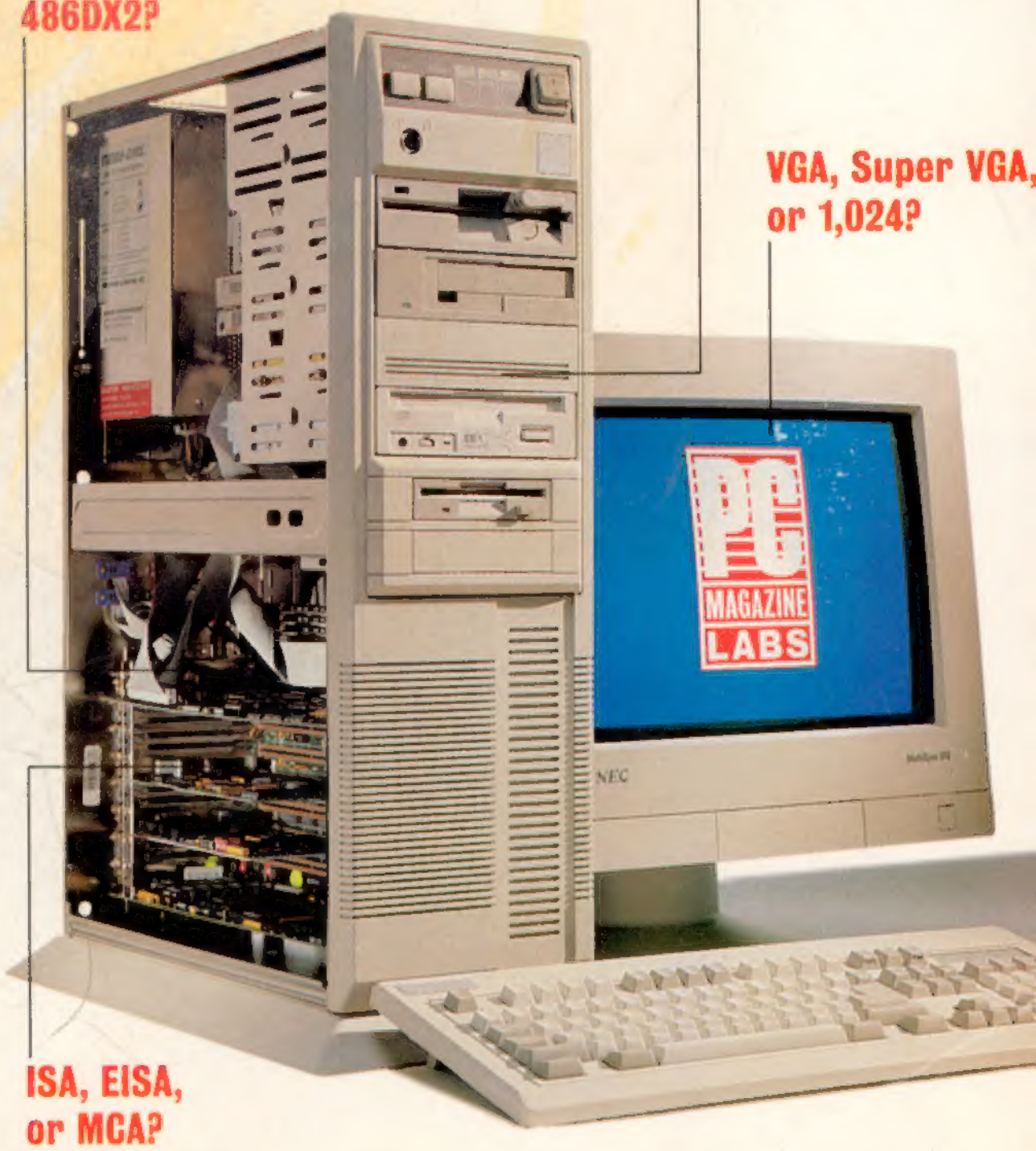
Free Utility: Control Your Windows Installations

C/C++ Compilers: Eight Development Systems That Do It All

SELECTING THE Perfect PC

Components That Make the Best

- Windows Workstation
- File Server
- Entry-Level Machine



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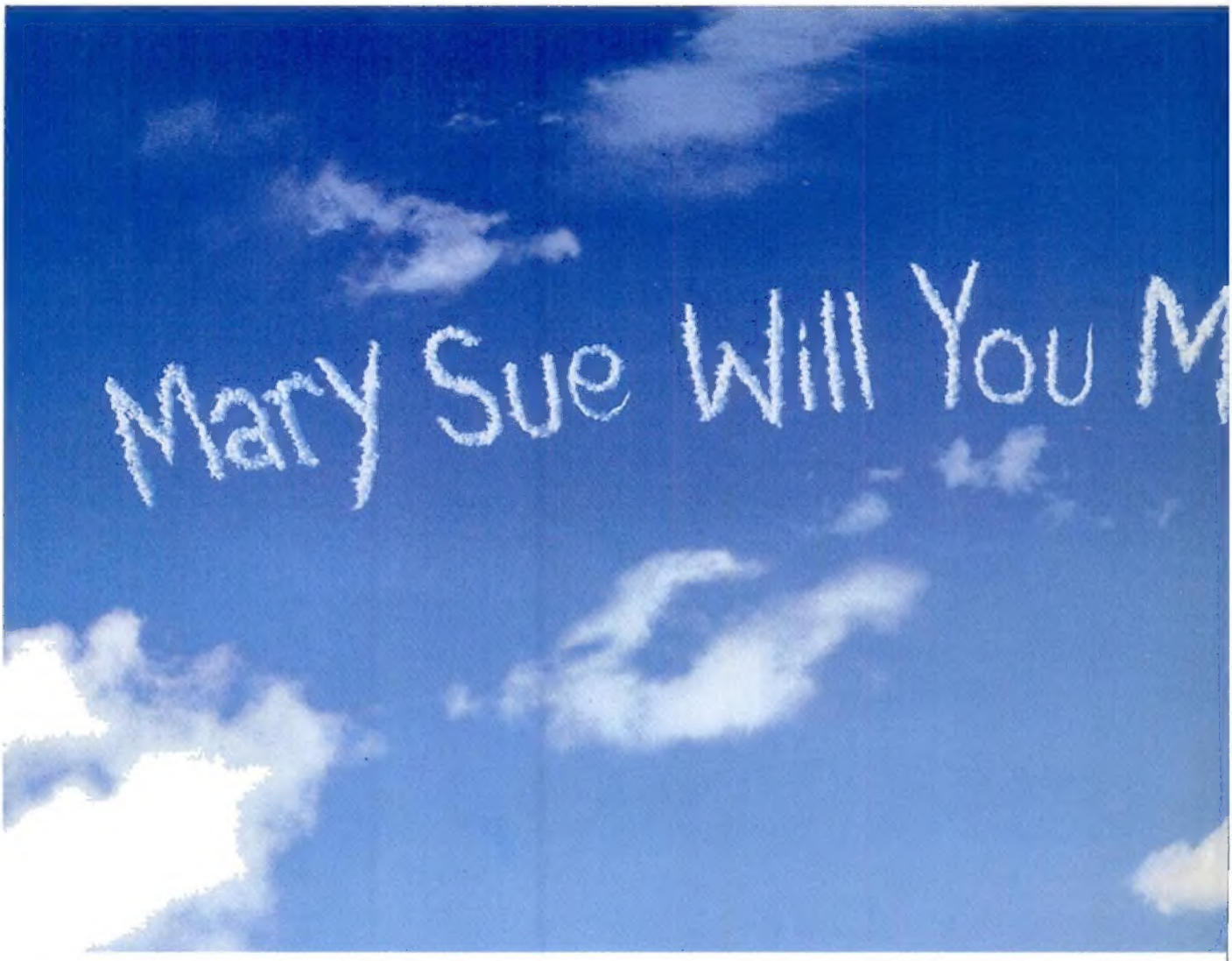
NEC introduces CD-ROM with MultiSpin.™

(Hold on to your seats.)



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CIRCLE 129 ON READER SERVICE CARD

Inside

WE'VE CHANGED our clothes. For the first time since 1989, we have revamped the appearance of *PC Magazine.* The new design is the result of consultation with some very important experts—you, our readers. Over the last 14 months we asked readers what they liked and disliked about *PC Magazine.* We queried you through a series of focus groups on both coasts, we sent out an editorial survey, and we analyzed the contents of the hundreds of letters we receive each month.

The loudest message was a desire for more clarity. Readers wanted to be able to find articles or reviews more quickly. They wanted to better understand the many graphs and charts that we publish in each issue. At the same time, they did not want to give up the level of technical and editorial detail that has made *PC Magazine* a unique resource.

What you have in your hands is the result of a lot of labor by a lot of people. Design consultant Ronn Campisi came up with the basic concept. "There is so much information in *PC Magazine* that the challenge was to make it all look like the same magazine," says Campisi. He accomplished that by simplifying our use of type, laying down rules about layouts and diagrams, and by rethinking many of the charts and drawings.

We think *PC Magazine* has become more "user friendly." Our table of contents grew by a page so we could add more detail. All major reviews will have an up-front index of the products in that review. The 3-D bar graphs, long a trademark of this magazine, have been replaced by 2-D graphs that are easier to read and provide more information.

The complex task of implementing Campisi's design fell to art director David Herbick and our art department. Herbick joined *PC Magazine* in February after six years at *Newsweek,* where he was the senior art director. The art department did double duty, getting out the magazine under the old design and preparing for the new look. Get used to our new duds and let us know what you think.
—Joel Dreyfuss

PHOTOGRAPH BY CHRIS BUCK

Herbick and Campisi: making it simpler.

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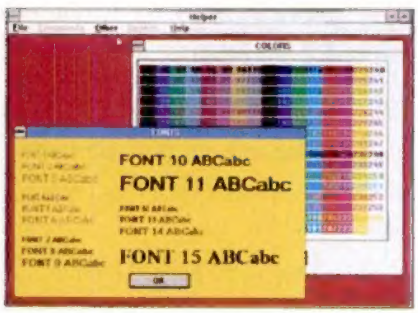

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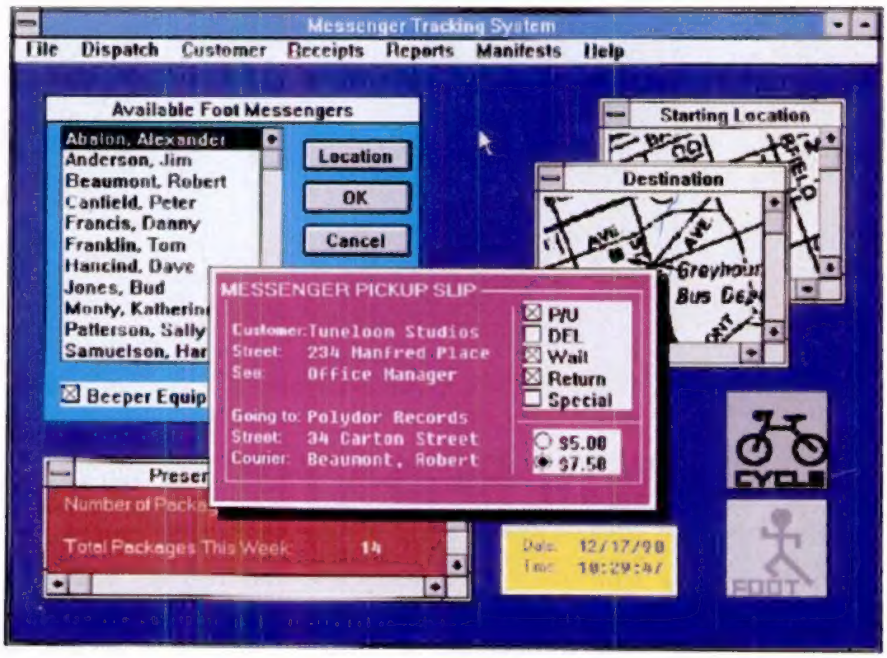

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CIRCLE 381 ON READER SERVICE CARD

Nov. 9, 1989 - The barrier between "the two Germanys" falls and the celebrations of freedom begin.

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COVER PHOTO BY RALPH MASULLO

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Computers

The Perfect PC

BY WINN L. ROSCH Configure your perfect PC with the fastest and most affordable components on the market today. PC Magazine Labs tests CPUs, hard disks, floppy disk drives, video adapters, and peripherals and helps you choose the best **110**

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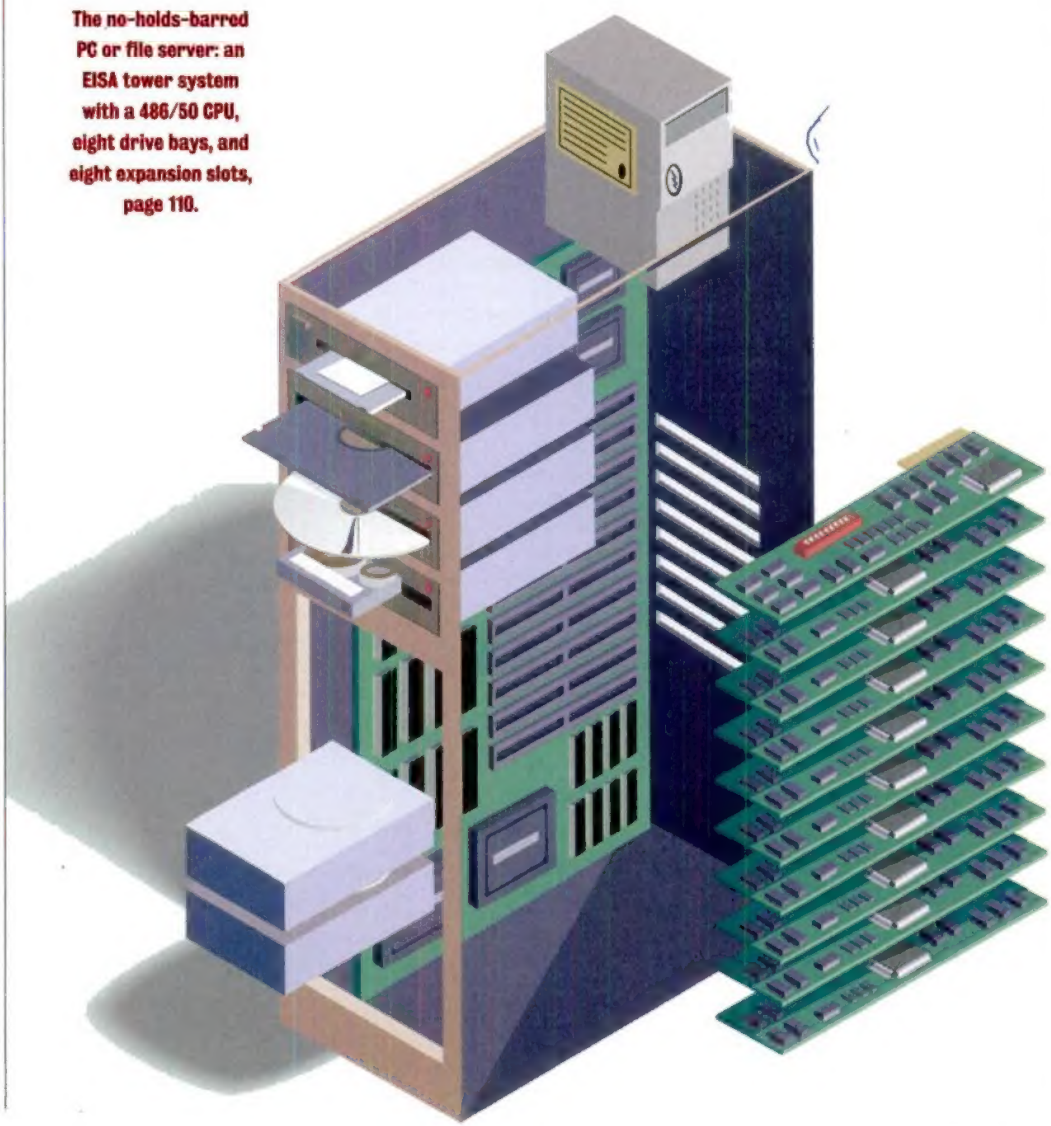

The no-holds-barred PC or file server: an EISA tower system with a 486/50 CPU, eight drive bays, and eight expansion slots, page 110.

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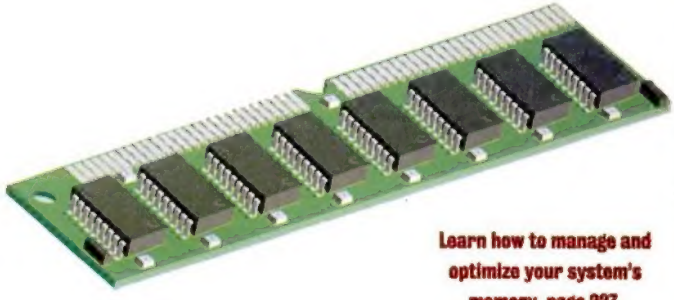

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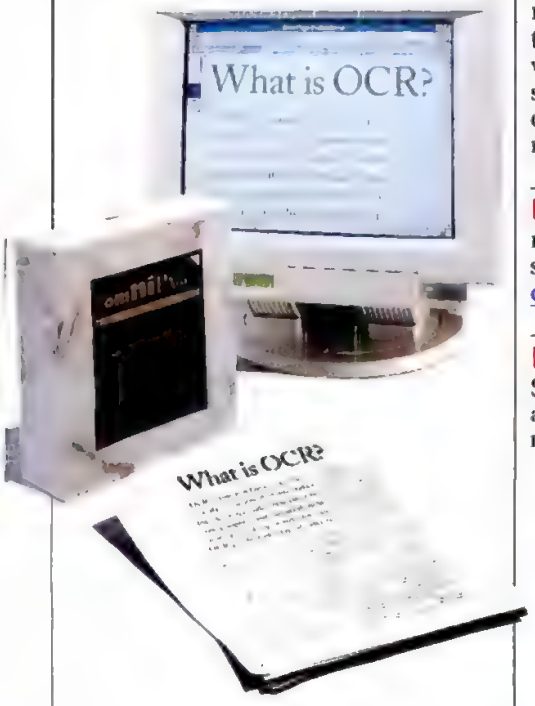

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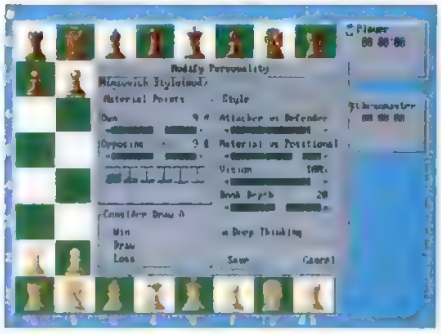
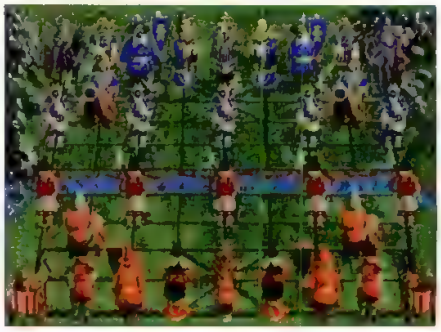
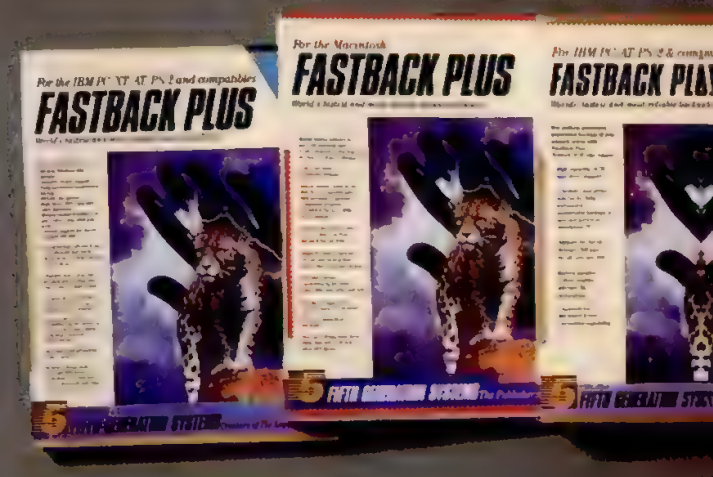




Backup. For people who don't.



Everyone who uses a PC ought to back up regularly. But most people don't back up at all.

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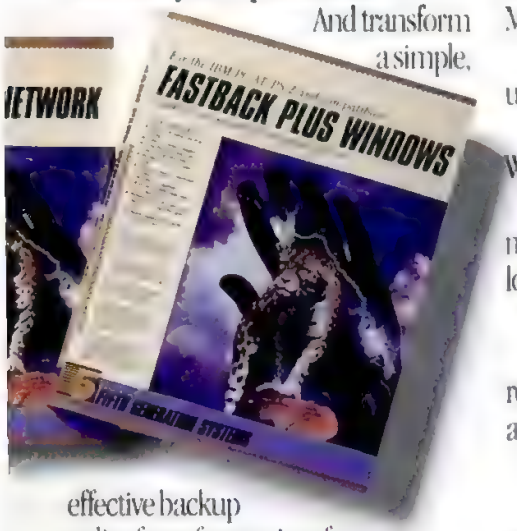

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PC Magazine Reviews

Except where noted: All *PC Magazine* reviews are of currently available products. Benchmark and performance tests are run on Compaq Deskpro 386/25s and 25e's.

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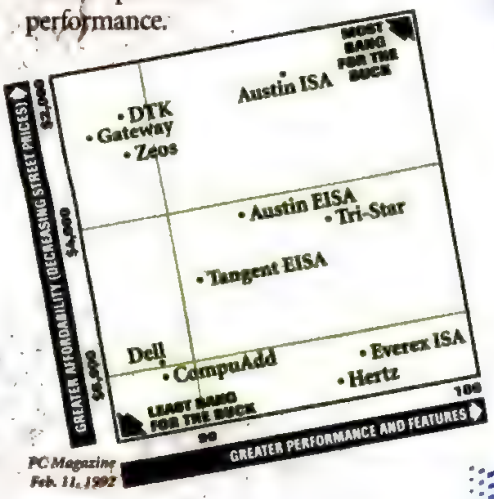

PC Magazine Feb. 11, 1992

[illegible] based on ten data points: [illegible] installed RAM, disk capacity, VGA RAM, free slots, drive bays and extras (miscellaneous items such as free bundled software, mouse, on-site service, FCC Class B certification, extended warranty policy and flash EEPROM). A set of weighting factors has been applied to the raw numbers; you can find this data in the Software Library of PC Magazine's Editorial Forums at #1BANG.WK1.

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386/SX20 U.K. 1991
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1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives
101-Key Keyboard	101-Key Keyboard	101-Key Keyboard	101-Key Keyboard	101-Key Keyboard
DOS 5.0/Windows 3.1 Mouse	DOS 5.0/Windows 3.1 Mouse	DOS 5.0/Windows 3.1 Mouse	DOS 5.0/Windows 3.1 Mouse	DOS 5.0/Windows 3.1 Mouse
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4MB RAM (to 32MB)	8MB RAM (to 32MB)	8MB RAM (to 32MB)	8MB RAM (to 64MB)	2MB RAM (to 8MB)
210MB Hard Drive	210MB Hard Drive	210MB Hard Drive	210MB Hard Drive	60MB Hard Drive
14" VGA 1024x768 Non Interlaced Color Monitor w/1MB Video RAM	14" VGA 1024x768 Non-Interlaced Color Monitor w/1MB Video RAM	14" VGA 1024x768 Non Interlaced Color Monitor w/1MB Video RAM	14" VGA 1024x768 Non-Interlaced Color Monitor w/1MB Video RAM	10" VGA LCD Display, 640x480 w/ 32 gray scale
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Letters

OS/2 FANS SOUND OFF

I was extremely displeased with the content of your April 28, 1992, issue. The cover tells the whole story. Windows 3.1, a product with only minor functional improvements (largely a bug fix) got about 50 percent of the front cover. On the other hand, OS/2 2.0, an entirely new product and a great operating system, got approximately 5 percent.

David August
Troy, New York

Your Windows-OS/2 cover story was a major disappointment. On both the cover and the headlines of articles, the magazine heralded Windows while questioning OS/2 ("Windows Enters Its Prime; OS/2 Is a Fascinating Technology but a Dubious Challenger," "Windows 3.1 Brings More of Everything," "OS/2 2.0: Does it Fulfill the Promise?").

I find it amazing that while IBM delivered all of the major promised features of OS/2 2.0, you essentially dismissed the operating system with a patronizing "nice try," while continuing to feed readers with Win32, Windows NT, and other vaporous "wouldn't it be cool" claims.

Arthur Goikhman
Brooklyn, New York

One of Michael Miller's five reasons not to buy OS/2: "The reason to choose an operating system is access to unique applications."

Huh? Right. We suppose you bought DOS so you could run EDLIN.

Stephen K. Sommers,
Brian A. Klaus,
Matthew S. Johnson
Houston, Texas

I can't believe *PC Magazine* announced "An end to UAEs" (page 123). Sure, Windows 3.1 eliminated some UAEs, but many are renamed, and a renamed UAE is just as frustrating to a user.

Kent Andrew Spencer
Arlington, Texas

Your editors awarded Word for Windows 2.0 an Editors' Choice ("Seven Windows Word Processors: What You'll

Let us now praise—and criticize—Windows 3.1 and OS/2 2.0.

See Is What You'll Want," February 25, 1992), though as a single application it consumes up to 15MB of storage space and requires 2MB of RAM. Several issues later, you labeled OS/2 a resource hog because it eats up 18MB to 20MB of hard disk space on the average system.

If a single application can receive praise despite its hefty storage space requirements, why do you fault an entire operating system for extracting only a slightly higher price?

Jim Levitt
Wahpeton, North Dakota

Michael Miller did your readers a great disservice with his biased and inaccurate comparison of OS/2 and Windows. What happened behind the scenes? Mr. Dvorak, what's the inside track on this?!

There is bias, damned bias, in Mr. Miller's comparison of OS/2 with Windows (with apologies to Mark Twain).

Dennis Boychuk
Ajax, Ontario, Canada

Perhaps Ziff-Davis should start a new publication that is devoted to Windows and let *PC Magazine* return to a general-interest format.

Chip Woodson
Atlanta, Georgia

OS/2 is a real operating system and requires 21 disks to install, but Windows needs 7 disks and DOS 5.0 requires 5. I can't understand why anyone would buy DOS 5.0 and Windows for a combined total price exceeding OS/2's release price, considering OS/2 runs multiple DOS and multiple Windows and multiple OS/2 applications concurrently.

Michael Reynolds
Beverly, Massachusetts

This is your brain: IBM OS/2 2.0.
This is your brain on drugs: Microsoft Windows 3.*x*.

Any questions??

Nelson Thaemert
Manassas, Virginia

...AND A FEW WORDS FOR WINDOWS

I want to commend you on the balanced coverage you gave Windows 3.1 and OS.2 2.0. The "Decisions, Decisions" column by Michael Miller filled a gap which, in my opinion, had been of Grand Canyon–like proportions in most earlier *PC Magazine* reporting. I think you would be performing a noble service by continuing, even expanding, the precedent set by Mr. Miller and report the pros and cons for every product. Then the reader can make a decision based on his or her own needs.

Joseph Ford
Atlanta, Georgia

As far as usability goes, we don't bother to train our people to use Windows; we just point them in the right direction. You'd be surprised at how quickly they come up to speed. With OS/2 2.0, that just won't work. The thing is incredibly difficult to use, and requires a lot more nonintuitive effort than is necessary to do the same tasks in Windows. Just try changing the icon in Workplace Shell.

Thanks for the great stuff on Windows 3.1; keep up the good work.

Robert E. Panick
Gibraltar, Michigan

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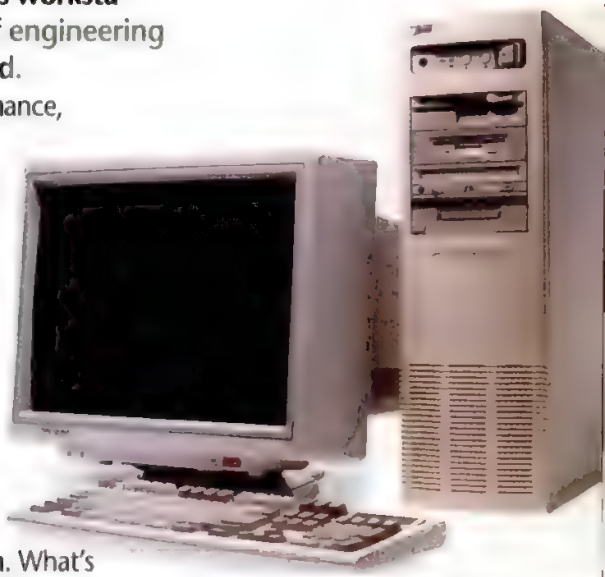

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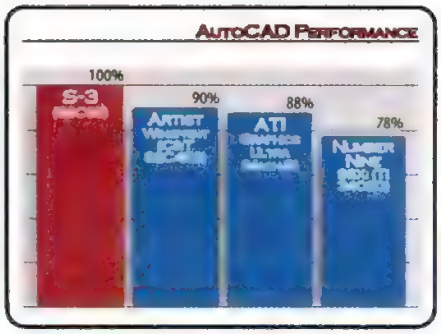
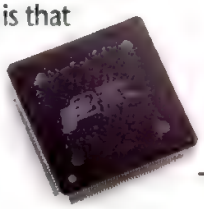


In PC Magazine's latest comparison of video chip performance tests running AutoCAD, the S3 based accelerators outperformed the competition, including the ATI Graphics Ultra, in all 10 categories except redraw where the TI 34020 took the lead.
Graph based on AutoCAD performance test results PC Magazine 3-17-91.



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CIRCLE 121 ON READER SERVICE CARD

LETTERS

it!), and one that allows you to work with DOS and Macintosh files and programs, do what I did: Get a Macintosh!

Nestor L. Montero
Atlanta, Georgia

Not once in all my experience using the Macintosh and its interface have I seen an error caused by the operating system itself while running a simple, common application. If Bill Gates can't do better than this, I may switch to DR DOS before MS-DOS 6.0 starts giving me UAEs.

Craig Davis
Charlotte, North Carolina

After reading Mr. Miller's "Decisions, Decisions" sidebar I decided to cut my losses, sell my IBM clones, and buy a bushel of Macintoshes! Long live Apple!

Lorne Zweig
Toronto, Ontario, Canada

LOGITECH SPARKS DEBATE

I never thought I'd praise a magazine for running an ad, but Logitech's MouseMan spread in the May 12, 1992, issue is too delightful to ignore. The "Feels Good/ Feels Better" image, obviously crafted by an agency genius with a profound sense of joy, not only grabbed my attention, but actually got me to read the copy! Thanks for giving me what I'd thought was impossible: an ad that stopped me, grabbed me, sent me off laughing, and actually caused me to write this letter.

Herb Goldstein
Bayside, New York

I was reading your magazine at the kitchen table during lunch and was shocked to see the Logitech ad, which depicts a naked child urinating into the air. Well I'm glad *somebody* feels better because the ad didn't do anything for my enjoyment of lunch.

Mitch Wright
Gurnee, Illinois

I know it is perfectly normal for babies to use the bathroom, but is nothing sacred in advertising anymore? You can pass on to Logitech that I am with a Fortune 500 company with over 10,500 employees and over 2,500 PCs, and they just "pissed off" a bunch of business!!!

Tom Metcalfe
Jackson, Mississippi

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WHAT ABOUT THE ENVIRONMENT?

In your April 28, 1992, Letters column you managed to offend a wide range of people, from dentists to anti-astrologers, and at least two people from Redmond, Washington. That's reason enough for me to renew my subscription; keep up the good work.

May I suggest that these people act like dieters and lighten up. There are lots of important things to be concerned about in this world. For example, I'd love to see an article about environmentally correct ways of disposing of old software. Are there organizations to which I can (legally) donate old software?

Jim Wright
Provo, Utah

• According to the Software Publishers Association, many software manufacturers will allow you to donate old software to nonprofit organizations, but your best course of action is to check with each manufacturer before making any donations.—Ed.

GRAPHICS GOOF

There's a serious error in your March 17, 1992, article "Graphics Accelerators: Pump Up the Power." You describe the performance of the two ATI boards on the 16-color Windows tests as "surprisingly low" and report that "the Graphics Ultra fell dramatically short of all the S3-based boards on the BitBlt tests." It is certainly surprising to see the Ultra reported as, in one case, ten times slower than the Graphics Vantage (which is the same card with slower memory). In the other tests it is, for the most part, much faster than its sibling. Presumably, had the right numbers been used throughout, its overall scores would have been much higher than the Vantage's and might well have been the best of the boards tested in this mode, as it was in all others.

Bruce Middleton
Cranbrook, British Columbia, Canada

• We did print some incorrect benchmark test results for the ATI Graphics Ultra. Upon reviewing the test data, we found that the Graphics Ultra actually took first place honors on our Graphics Intensive (16-color) Windows benchmark test. On the Text Intensive (16-color) Windows benchmark test, the Graphics Ultra was in seventh place, not the ninth place we reported. Our reviewer did, though, remark on the strong performance of the ATI Graphics Ultra.

CORRECTIONS & AMPLIFICATIONS

In "Minicartridge Tape Backup: Simple, Inexpensive, and QIC," April 14, 1992, we should have noted that Colorado Memory Systems also offers an MCA and an 8-bit ISA interface for its Jumbo 250 External tape backup system.

In the April 28, 1992, "Gain with No Pain?" Windows 3.1 compatibility chart, we should have said that Okidata Corp.'s printer drivers are not available via download. The technical support number is 609-273-0300.

IntelliLink (First Looks, April 28, 1992) can identify schedule conflicts when you move a schedule from a palmtop to a host PC, but can't reconcile schedules in the other direction.

Lotus Development Corp.'s Macro Developer's Kit for Ami Pro, Version 1.0, reported as free to registered Ami Pro users (New & Improved, May 12, 1992), carries a $9.95 shipping and handling charge.

HOW TO WRITE TO PC MAGAZINE

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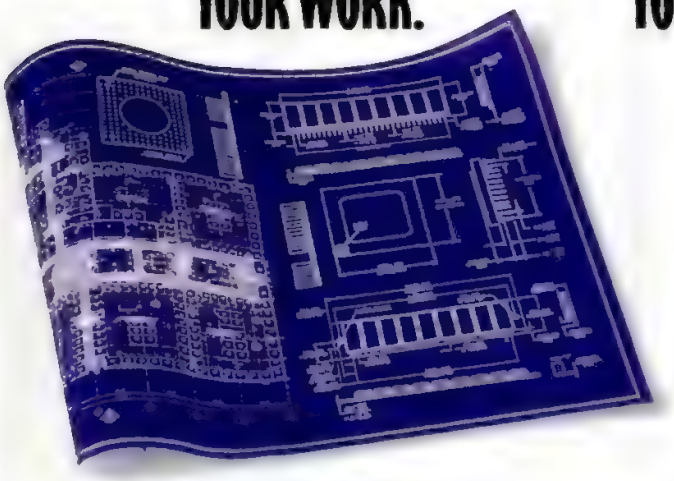

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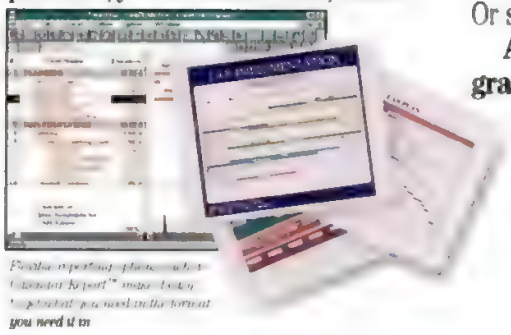

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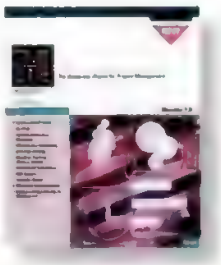

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CIRCLE 344 ON READER SERVICE CARD

IBM and Compaq Fight Fire with Fire

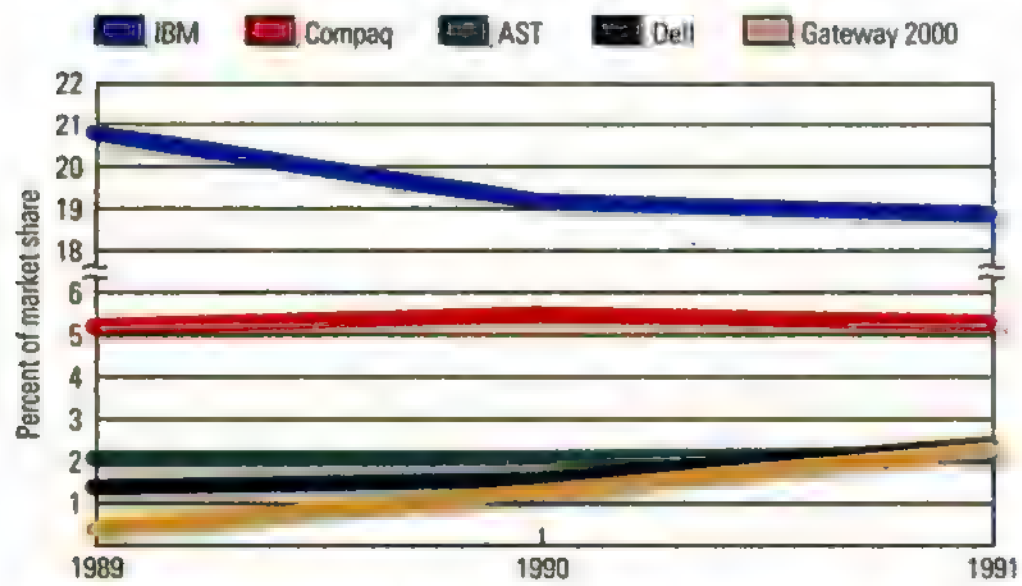
Prices slashed to beat mail-order mania

Lower-cost competition has been plundering IBM's PC business for years. Even Compaq, IBM's first cloner, priced itself out of a market that has been increasingly gobbled up by ALR, AST, Dell, Gateway, Zeos, and a host of offshore others. But the PC giants are mad as hell and they aren't going to take it anymore. In order to fight back, IBM is going toe-to-toe with 800-number mail-order houses, while Compaq is planning to outflank them all with the introduction of two entirely new low-end lines.

Compaq is counterattacking aggressively with the new ProLinea line as its entry-level series. With prices beginning at less than $1,000 for a 25-MHz 386SX system with 2MB of RAM and a 40MB hard disk (but without a monitor), Compaq is finally putting its foot—and high-price reputation—down. The ProLinea series is designed and manufactured by Compaq to provide basic functionality. Its street price with a monitor will be around $1,300. (See First Looks, "How Low Can They Go?" on page 37.)

Value pricing, which was Greek to Compaq until now, will also be applied to a new family of entry-level notebooks. Compaq has now announced a midpriced Deskpro/i series, which will start below $2,000, and eight new models for the Deskpro/M line.

The bottom line: mail-order market-share gains.



Since 1989, IBM's U.S. market share of Intel-based units has declined, while mail-order companies have enjoyed a steady upswing.

With an 800 number, IBM is testing the burgeoning direct market—something it knows very little about—with three bullets aimed at Dell, Gateway, and Zeos. The company lowered the price of the AT-bus PS/2 Model 35 SX—a 20-MHz 386SX with 2MB of RAM, a 40MB hard disk, and a color monitor—to $1,495. *Continues on page 32*

SNMP Networks Get More Secure

THE SIMPLE NETWORK MANAGEment Protocol (SNMP) lets you manage your network, but at what price? Without security, users can read sensitive network information from bridges, wiring hubs, and routers. Even worse, they can reconfigure them. Until now, there's been very little network managers could do to protect themselves. Most just turned off users' ability to reconfigure SNMP devices remotely. That's great, but it means using only half of what you paid for.

With the explosive growth of networks, however, the demand for tighter security has put new pressure on developers to come up with solutions. The Internet Engineering Task Force (IETF), the group responsible for the TCP/IP protocol, is now working on a standard that defines the protocols and variables needed for a secure SNMP. An encryption scheme prevents users from retrieving unauthorized information.

The new IETF standard is just the latest move to support security. Wiring-hub vendors Ungermann-Bass, Synoptics, and 3Com have all announced special security measures for preventing unauthorized access on Ethernet LANs. The Institute of Electrical and Electronics Engineers has also created a security working group (called 802.10) to develop an encryption and decryption algorithm on all IEEE networks.—*David Greenfield*

Database Mergers: What Happens to The Developers?

THE FINE ART OF MERGING TWO corporate cultures won't show up on any spreadsheet, but it's an essential component of any acquisition. Doing it right is

Pipeline *By Gus Venditto*

EISA: More Affordable The Second Time Around

EISA (Extended Industry Standard Architecture) has never had an easy time of it. From its very public birth in 1988 until very recently, this 32-bit expansion of the PC bus generated more talk than action. At first, there was a year of quasi-public development by the "Gang of Nine," which led to divisive industry gossip over who was calling the shots, whether there really was an open exchange of ideas, and whether the architects were looking far enough into the future.

Then, when the first EISA PCs began to ship, we were asked to pay a big price premium—in the range of $1,000—without seeing any clear evidence that the bus was any better than its 16-bit predecessor. Indeed, a June 1990 *PC Magazine* report found no significant benefit from an EISA machine.

Since then, a range of bus-mastering EISA disk controllers—especially those from Adaptec and UltraStor—have demonstrated a clear value for EISA. Yet the price gap between EISA and ISA systems is still as much as $500.

PETER GREGORE

That's about to change. A new chip set from OPTi is now being used by system board designers and will soon show up in a flood of new machines. Pioneering system makers say the price difference will soon be close to $100 and may eventually cease to exist. The main reason for the price drop is that OPTi, which is breaking an Intel monopoly for the EISA bus controller chip set, will sell its product for about one-quarter of Intel's price ($50 to $80 instead of $200 to $250). Since the cost of a motherboard's components is usually doubled when setting the retail cost of a system, a 25 percent drop means that EISA's $500 premium will descend to about $125. Since a motherboard built with OPTi's product will require fewer chips, smaller cases will become possible in EISA systems for the first time. Until now, EISA motherboards have required towers or full-size AT-level cases. The OPTi set consists of only four chips; Intel's chip set requires more than 20.

The renaissance of the EISA bus will run headlong into the growth of local-bus systems. For now, the distinction between the two types of systems is that a local bus is the way to go for fast Windows performance where video speed is a top priority; EISA is the preferred choice for applications with heavy file access. The differences should eventually go away, since the local bus is a natural extension for an EISA system, but it could take another six months before a composite system emerges.

Gus Venditto is editor of PC Sources *and a contributing editor to* PC Magazine.

one of the challenges facing the three big players in the database market: Borland (which bought Ashton-Tate a year ago), Microsoft (which is buying Fox), and Computer Associates (which recently announced it would buy Nantucket).

Merging Ashton-Tate into Borland may be more expensive than originally thought (Borland posted a first-quarter $30 million restructuring charge), but the process is running smoothly on the research and development side, according to Rob Dickerson, vice president of product management. Based on Borland's past acquisitions—including Ansa (Paradox) and Surpass (QuattroPro)—Dickerson says moving the new team to corporate headquarters is important because "you don't want two corporate cultures growing up independently. It makes it impossible to fix anything when something goes wrong." Borland did wait, however, until dBASE 1.5 got out the door before moving Ashton-Tate's development team from Torrance to Scotts Valley.

While the Interbase team shared some of the aggressive "barbarian" style that's a Borland trademark, the dBASE team were different. They were "gun shy at first," says Dickerson. "At Borland, we have a very proactive approach to problems. We want to find them and we want to fix them. But at Tate, people seemed to get in trouble for raising problems." Other differences include interoffice communication. "At Tate there were lots of big, thick documents. At Borland, everything's done on e-mail. But they're fitting in much faster than we expected. Now they're going out for pizza with us."

Although Microsoft is content to leave the development team from PowerPoint (which it bought three years ago) in Sunnyvale, California, as a self-contained graphics division, the company is currently moving the Fox developers from Perrysburg, Ohio, to Redmond, Washington, where they will work closely with the developers of Microsoft's upcoming Windows database, code-named Cirrus.

Frank Gaudette, CFO of Microsoft, says that most of the developers are making the move and that the deal wouldn't have come through otherwise. "We're paying for the smart people," he explains. He says the two companies share a common culture that is based on "reverence for the developer." At Microsoft, this means that every programmer gets a window office and is encouraged to decorate it with a personal touch. Gaudette believes that Fox founder David Fulton, who will head up Microsoft's database development, and Microsoft CEO Bill Gates "share the same vision of exactly where they're going."

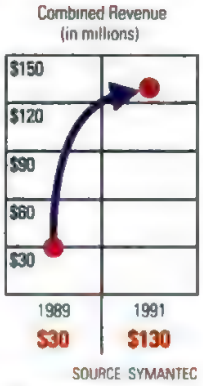
At Computer Associates, CEO Charles Wang says, "We have 40 companies under our belts, and we're happy with 96 percent of the acquisitions we've made." CA, which is a major player in mainframe software, bought Nantucket as part of its campaign to sell even more Windows applications than Microsoft.

At press time, CA was still deciding how to integrate Nantucket's Clipper and Aspen (an object-oriented Windows database in development) with CA's dBFast. Wang was unable to say whether or not Nantucket developers would have to move from laid-back Los Angeles to the suit-and-tie world of New York, and

whether or not CA would sell one Windows database or two. Wang's advice to his developers is, "Don't bet your career on one product. Bet it on CA."
—*Mary Kathleen Flynn*

Case Study: Why Symantec-Norton Marriage Works

BORLAND, MICROSOFT, AND COMPUTER Associates could learn a thing or two from Symantec, whose acquisition of Peter Norton Computing two years ago is widely cited as a success by such industry leaders as Slate founders Dan Bricklin and Tom Byers and venture capitalist Ann Winblad. We asked Mark Bailey, Symantec director of business development, to describe Symantec's strategy and to share some tips.



Symantec's utilities generated $130 million in revenues last year, more than four times the 1989 pre-acquisition utilities revenues of Symantec and Norton combined.

"As soon as possible, hopefully on day one, you have to let every employee know how the move is going to affect them," advises Bailey. "You have to minimize the uncertainty. Then you've got to define the company's mission and outline their roles, show them where they fit in. You have to explain the reasons behind the merger and how it will benefit them, how there will be more resources available to market their products."

A key part of Symantec's strategy is to have an on-site manager who acts as the liaison to the rest of the company. Rod Turner played that role in the Norton acquisition. "It was Rod's job to present the team's viewpoint to the rest of the company," explains Bailey. "We also put together a cross-function task force that meets weekly to integrate the new team into the organization. They make sure nothing falls through the cracks."

And on the controversial subject of geography, Bailey says, "We've had good luck keeping the development teams where they are. It's very important to respect and preserve cultural differences. There's a core of shared values—passion and enthusiasm for great products—but there's got to be room for diversity within a company."

Finally, access to the management team is a key. "CEO Gordon Eubanks was very accessible to the Norton developers. He's got a technical background and has a very good rapport with programmers. He understands their concerns and spends lots of time with them."
—*MKF*

Top Retail Software

Current ranking	Last issue	Product/ Company
1	1	**Microsoft Windows 3.1 Upgrade** *Microsoft Corp.*
2	3	**Microsoft DOS 5.0 Upgrade Kit** *Microsoft Corp.*
3	6	**QEMM-386 6.0** *Quarterdeck Office Systems*
4	2	**Microsoft Windows 3.1** *Microsoft Corp.*
5	7	**WordPerfect 5.1 for DOS** *WordPerfect Corp.*
6	—	**Lotus 1-2-3 for Home** *Lotus Development Corp.*
7	4	**Excel for Windows 4.0** *Microsoft Corp.*
8	—	**Windows TrueType Font Pack** *Microsoft Corp.*
9	10	**Stacker 2.0** *Stac Electronics*
10	5	**Excel for Windows 4.0 Upgrade** *Microsoft Corp.*
11	—	**Word for Windows 2.0** *Microsoft Corp.*
12	9	**Procomm Plus 2.1** *DataStorm Technologies*
13	—	**WordPerfect 5.1 for Windows** *WordPerfect Corp.*
14	11	**Word for Windows 2.0 Upgrade** *Microsoft Corp.*
15	—	**C/C++ Compiler 7.0 Upgrade** *Microsoft Corp.*

The list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending May 9, 1992. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market. Sales information compiled by Ingram-Micro.

The Incredible Shrinking Hard Disk

MASS STORAGE DEVICES HAVE been dieting lately. The 5.25-inch platter for the PC gradually slimmed down to 3.5 inches, then 2.5 inches, and early this year down to 1.8 inches (see Trends, January 14, 1992). Now Hewlett-Packard has brought out a 1.3-inch platter—about the size of a half-dollar. This svelte microdisk, code-named Kittyhawk, is expected to be used in "mobile information appliances," which is Hewlett-Packard's term for its next generation of palmtops, due in early 1993. NCR is looking at Kittyhawk for its next generation of hand-held pen computers.

While other companies pursue solid-state storage using flash memory chips (Trends, June 30), Hewlett-Packard developed the world's smallest hard disk because it's cheaper than flash memory and smaller than a PCMCIA card (which is credit card–size). Intel's 20MB Series 2 Flash Memory Card costs system makers nearly $600, whereas HP's Kittyhawk will cost only $250 for the same capacity.

HP's 1.3-inch hard disk (actual-size photo) makes even 1.8-inch disks (outlined) look too big.

Kittyhawk has two platters and can write 7MB on three sides (the fourth is too close to the case), for a total of 21MB. It has an IDE or PCMCIA interface, which means it can be used in the same socket as flash memory cards. It's ruggedized to handle the punishment of being tossed around without failing. But don't drop it; you may mistake it for a matchbox.—*Christopher Barr*

Practical Fractals

FRACTALS ARE THE STUFF OF high-tech cocktail-party chatter. Until recently, they were best known as a meeting point for the worlds of art and mathematics. Fractal painting and fractal music compositions delighted the avant-garde with haunting random repetitions and iterations.

Now Iterated Systems, from Norcross, Georgia, has bottled the essence of fractal mathematics in an image-compression technology that may prove to be the best answer for storing and delivering image-intensive media. The major competitor to Iterated's FIF (Fractal Image Format) is the better-known Discrete Cosine Transform (DCT) technology used, for example, in JPEG compression schemes.

DCT technology actually drops "bits" of information out of an image during the compression process, figuring that your eye will "compensate" for the missing pieces. Fractal compression, on the other hand, whittles down the size of an image by figuring out its "repetitive patterns" and storing them as mathematical formulas.

Because it's pattern- and not pixel-based, fractal compression is resolution-independent. It can be decompressed to various resolutions and color depths both higher and lower than the original image. And although fractal images take a great deal of computing power on the compression end (while it is possible to compress an image without hardware assistance, it's not always practical), they can decompress rapidly (in a matter of seconds) on standard 386 PCs. But perhaps the most exciting aspect of the fractal compression scheme is a new technology that Iterated calls Fractal Transform Resolution Enhancement. With Fractal Transform, detail can actually be added to an image during decompression, based on the information stored in the patterns.

Iterated Systems' $299 Images Incorporated DTP package uses Fractal Transform Resolution Enhancement to add more detail to images (top) than is possible with traditional Discrete Cosine Transform (bottom).

Until now, Iterated Systems was selling mathematics, not commercial reality. Recently, in a nonexclusive agreement, Microsoft's Multimedia Publishing Group licensed Iterated's fractal compression technology to be incorporated in an unannounced CD-ROM–based multimedia reference work.

And perhaps it's poetic justice that Amaze (makers of cartoonist Gary Larson's Far Side Computer Calendar) will use Iterated's fractal compression to squeeze the information that gets distributed as yearly cartoon updates into a manageable delivery form. The U.S. Commerce Department is staking $2,000,000 for the creation of a fractal decompression chip, presumably to be used in HDTV and videophones.

Iterated Systems' own product, the $299 Images Incorporated, is geared toward the desktop publishing market.
—*Robin Raskin*

Briefs

SHARING DATABASES WILL BECOME MORE IMPORTANT as PC users embrace client/server computing in workgroups, which is one of the reasons database vendors are pushing for a standard Xbase language. Ashton-Tate's dBASE has long set the de facto standard for Xbase compatibility, but now that several major players have entered the market (with Borland's purchase of Ashton-Tate, Microsoft's purchase of Fox, and Computer Associates' recent intent to purchase Nantucket), the X3 Standards Planning and Requirements Committee has approved a proposal to develop an ANSI-standard Xbase language. Borland, the Emerald Bay Group, Fox, Microsoft, and WordTech have all voiced support for the standards effort.

PC MAKERS WHO WANT NETWORK CONNECTIVITY on the motherboard have a new chip choice: Advanced Micro Devices has introduced a new 10BaseT Ethernet chip. Intel also makes an Ethernet chip for system boards, and Texas Instruments sells a combined Ethernet and Token-Ring chip.

THE ADVANCED COMPUTING ENVIRONMENT initiative may be burning out, but it may also have already served its purpose: lighting a fire under Intel. Cofounder Compaq recently resigned from the organization, which was formed last year to bring RISC-based commercial systems to market. Compaq senior VP Gary Stimac acknowledged that the ACE Initiative "has been a major catalyst for change in our industry," but endorsed Intel's forthcoming chips, citing Intel's "dominant commercial market share and aggressiveness in future processor development, coupled with a number of next-generation operating systems now being ported to Intel platforms."—*Mary Kathleen Flynn*

Fighting Fire

CONTINUED FROM PAGE 29

IBM is also offering the Model 40 SX at $1,595 and the L40 386SX laptop for $1,695. These prices, although slashed significantly from the original list prices (especially the L40 386SX laptop, which was $5,995), are still higher than most mail-order systems. And almost all mail-order firms offer an assortment of processor platforms and configurations, not just low-end 386SX machines. IBM says this foray into the mail-order channel is a test. It had also discussed acquiring Northgate Computer Systems.

Compaq's leap into the cutthroat market of inexpensive systems is likely to lower overall prices even more. Months before Compaq announced the ProLinea line, ALR jammed more models into its low-cost Flyer series, with 386SX systems priced below the magical $1,000 threshold.—*Christopher Barr*

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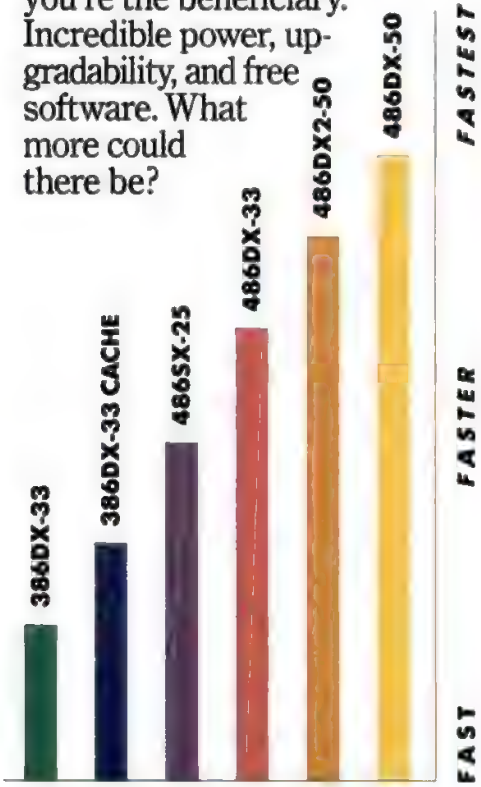

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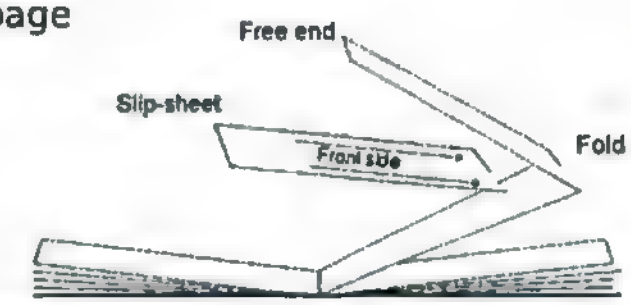

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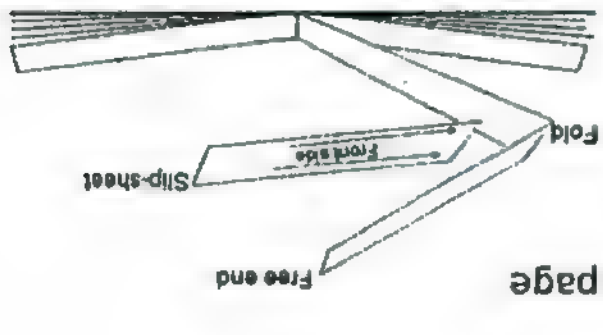

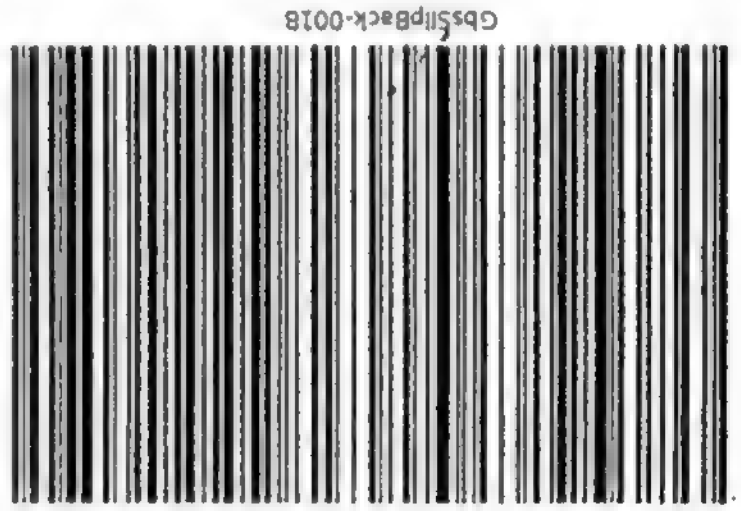

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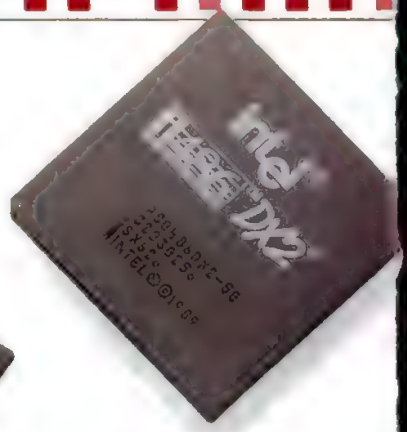

WHAT SHOULD I GET?

How should you configure your new ZEOS 486-50? Of course the best answer depends on your needs and what you plan to use your new system for. But never before has so much power been available to everyone at such a low price. Our suggestion would be to consider investing in two areas when you buy your new 50MHz system. The memory and drives. Particularly the memory.

From what we're hearing, memory will be important with the new operating systems debuting later this year. We would strongly recommend at least 4 megabytes, eight if it's in the budget. As for drives, think in terms of 100+ megabytes; applications just don't seem to be shrinking (however, before you go too wild, remember you can always add more drives). Both of our

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Soc. Sec. No. _____ Date of Birth ___/___/___

Address _____ Apt. _____

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Since? (Mo./Yr.) _____ ☐ Buy ☐ Rent ☐ Other _____

Previous Address _____

City _____ State _____ Zip _____

Employer _____ Since? (Mo./Yr.) _____

Monthly Gross Salary $ _____ Daytime Bus. Phone (____) _____

Previous Employer _____ From _____ To _____

Occupation _____

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Name & Address of Nearest Relative Not Living With You _____

_____

Relationship _____

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Checking Account ☐ Yes ☐ No

Savings Account ☐ Yes ☐ No

	Y/N	How Many?		Y/N	How Many?
Bank Loan	___	_____	Dept. Store Charge Card	___	_____
VISA	___	_____	Credit Union Account	___	_____
MasterCard	___	_____	Other Major Charge Cards	___	_____
Finance Company Loan	___	_____			

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Address _____ Apt. _____

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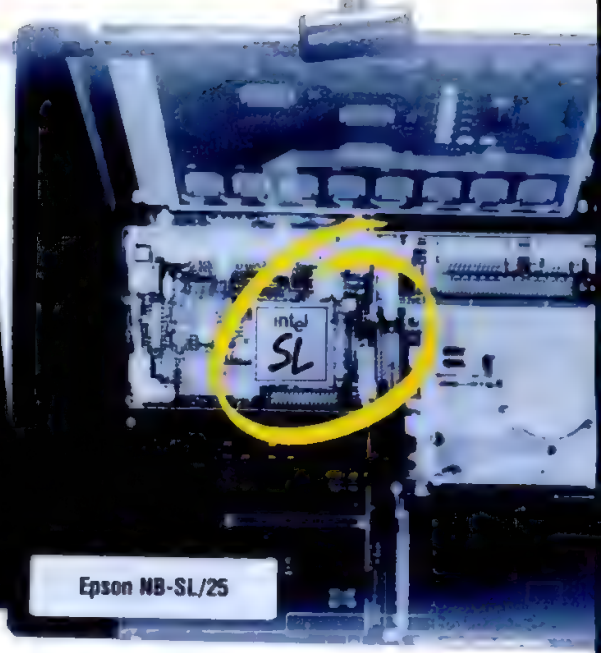

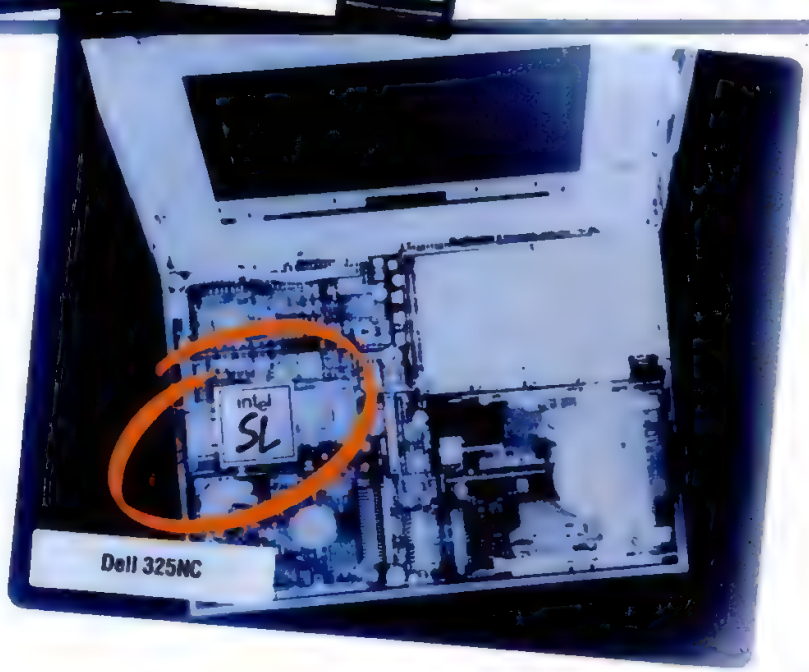

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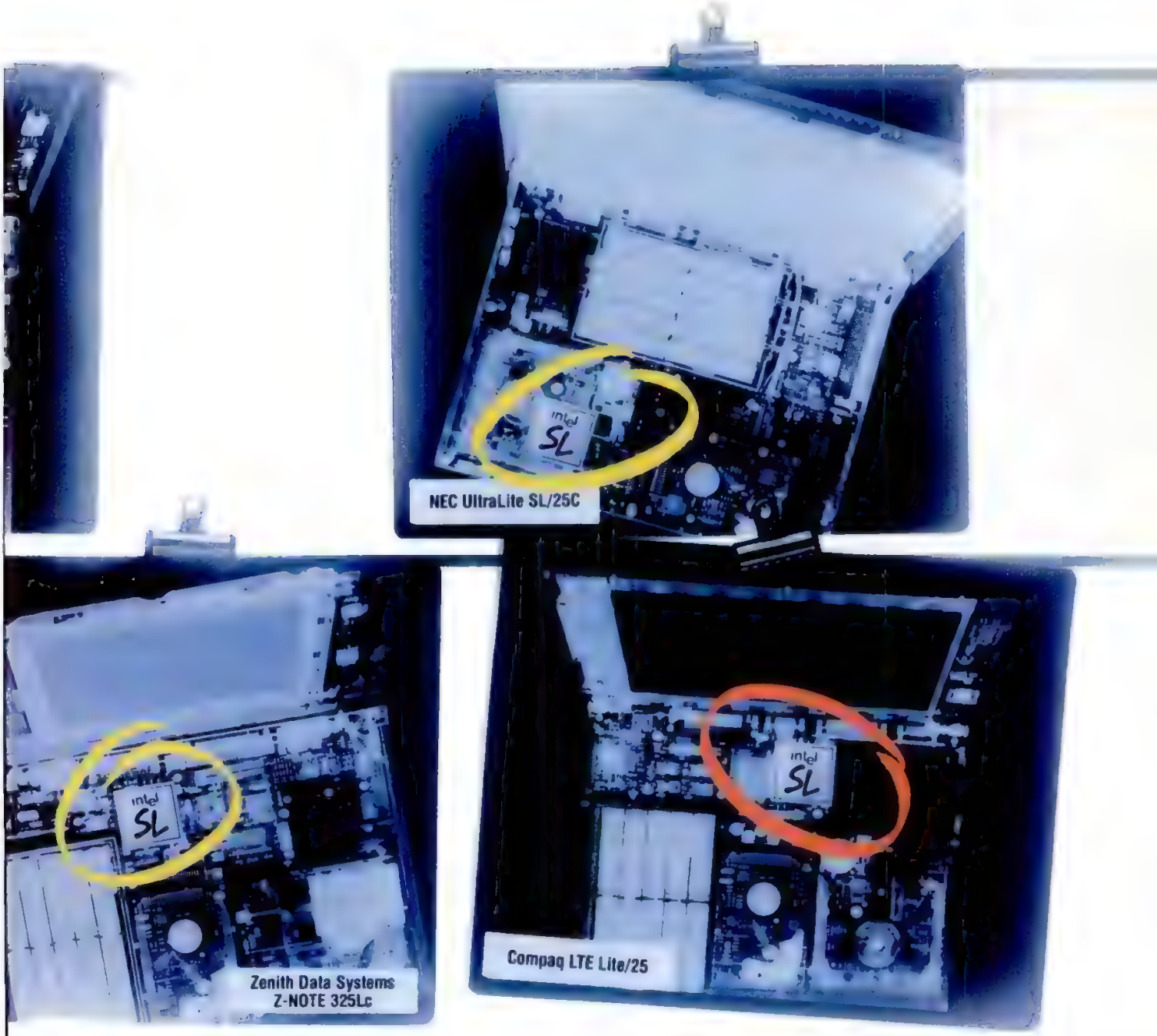

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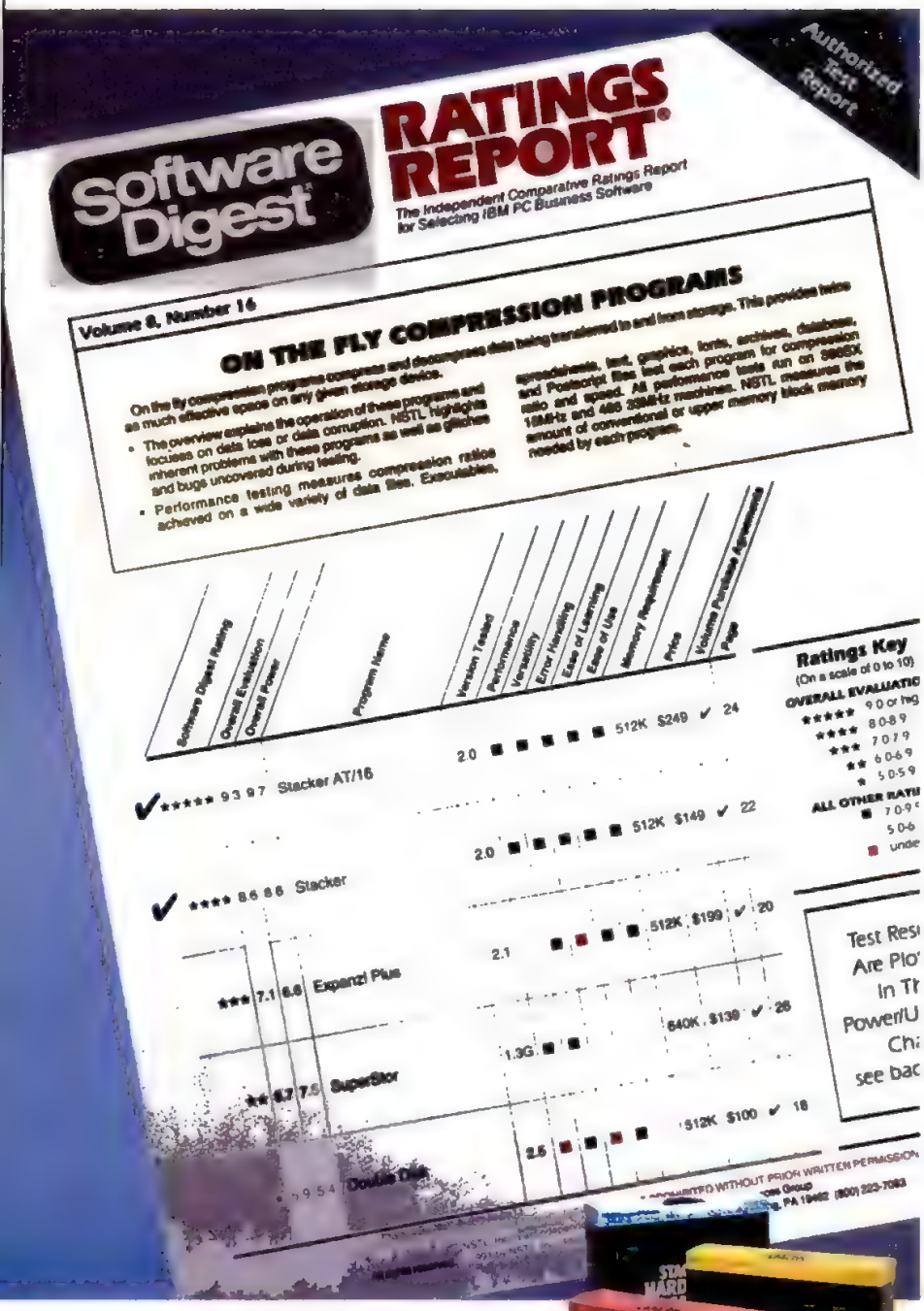

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How Low Can They Go?

New Compaq Systems Target Mail-Order Buyers

BY GREG PASTRICK

To say that Compaq has been sensitized to the aggressive pricing schemes and success of direct-market PC vendors is an understatement. In order to change the widely held perception that you always pay premium prices for a Compaq, the company has made a radical departure from its traditional pricing structure.

Compaq has stepped away from its traditional high-price positioning with the release of new inexpensive entry-level and midrange lines. Called the ProLinea and the Deskpro/i series, the systems are built around a range of processors, are matched with standard memory and hard disk configurations, and offer limited expansion options.

All the systems are based on what Compaq calls "mature technology." That means ISA system boards, frame/buffer Super VGA display capabilities, and IDE disks. This strategy has made Compaq successful in lowering its price points, but it has traded off some performance to get there.

PROLINEA: *Small-footprint systems start under $1,000.*

PROLINEA

At the low end we find the entry-level ProLinea 3/25zs Model 40, a small-footprint 25-MHz 386SX that comes with 2MB of RAM, no caching, a 40MB Quantum ProDrive, a Paradise Super VGA display system with Western Digital chip set, a 3.5-inch floppy disk drive, and two 16-bit expansion slots. With a 70-watt power supply running this 3.5- by 12.5- by 15-inch

• *Continues on page 38*

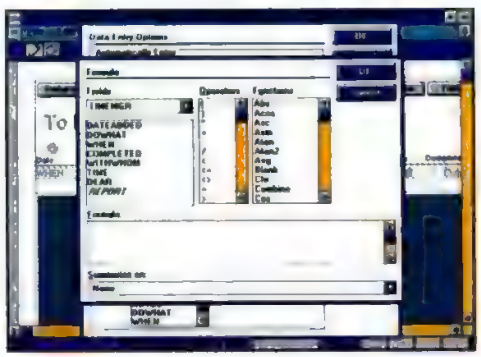
Databases

Approach Proves that Databases, Too, Can Thrive in Windows

BY RICHARD HALE SHAW

Database managers haven't flourished under Windows like spreadsheets and word processors have. There's Software Publishing's SuperBase, which hasn't evolved much in the three years since we first reviewed it, and there's Ace Software's AceFile, which shows promise but lacks the power you would expect. So it's a real treat to find Approach for Windows, a nonprogrammable Windows-based database manager, from Approach Software.

Approach is an end-user program with a sophisticated, well-integrated, and easy-to-use interface that anyone with a fundamental knowledge of databases and Windows can use. It's chock full of conveniences that make it easy to manipulate tables, records, and fields and access them across a network. You can generate forms, reports, and mailing labels in no time, and create visual front ends to existing databases.



EASY TO USE: *Approach offers dialog boxes for changing database and field definitions, as well as formula-based fields.*

Unlike most database managers, Approach isn't married to one database format but is compatible with files from dBASE III Plus, dBASE IV, Paradox, and Oracle SQL. You can open multiple files of any type, create relations (one-to-one and one-to-many) with a few

• *Continues on page 39*

Compaq

CONTINUED FROM PAGE 37

(HWD) system, you get just enough computer to do what you have to do, and not much more.

The 3/25zs got a low overall ranking on the PC Magazine Labs processor and memory benchmark tests, though it placed higher in disk and video performance. But average performance matters less to Compaq than the fact that it can price the system under $1,000.

DESKPRO/I: *Systems start under $2,000, without a monitor.*

That's as specific as Compaq would get on pricing at press time. We do know that the system also has a 120MB hard disk option in its small-footprint configuration, which Compaq says will be priced well under $2,000.

Other ProLinea models are larger: a 4- by 15.5- by 15-inch slimline chassis has an upgradable system board with either a 25-MHz 386SX or 33-MHz 486DX processor and an additional expansion slot. The ProLinea 3/25s comes standard with 2MB of RAM, while model 4/33s comes with 4MB of RAM and no external caching. Each has 84MB and 120MB hard disk options, and each will be priced under $2,000 without a monitor.

Compaq's 14-inch multifrequency monitor or its 15- or 17-inch flat tension QVision display options for the Deskpro/i series will add $450 to $550 to system prices, on the average. Memory upgrades for the ProLinea line top out at 16MB, but the base prices remain below $2,000.

DESKPRO/I

The Deskpro/i series, which incorporates such options as 64K external processor caching, QVision video acceleration with 512K minimum VRAM, custom input/output sound chip technology, and three expansion slots from a proprietary 32-bit backplane, is based on an upgradable system board that holds a maximum of 32MB of RAM.

Processor options include 25-MHz 386, 25-MHz 486SX, and 33-MHz 386. With a standard 4MB of memory and either the 84MB or 120MB hard disk option, these systems' prices will also be below $2,000, without a monitor. Compaq is also preparing to release 33- and 66-MHz 486DX models with 120MB or 210MB hard disks for under $3,000.

Testing of the Deskpro 3/33i and 4/33i Model 84 showed that Compaq has lost little of its performance edge. The rankings for processor, memory, disk, and video tests place the 3/33i and 4/33i on a par with machines in their classes.

WINMARK Windows graphics speed tests for the QVision video accelerator yielded incredible performance—among the fastest we've seen for any system. It was especially noticeable in the performance of the 3/33i at 640-by-480 with 256 colors, and across all resolutions in the 4/33i. But despite this impressive performance, without video coprocessing capabilities, Windows still slows to a crawl when the processor is occupied with duties other than processing on-screen graphics.

The Deskpro/i's sound features include a four-plug array for microphone, headphone, and input/output lines. Though it has no FM-synthesis capabilities, it's able to process 16-bit sound at 44 kHz. Annotating voice files is its primary reason for being, but the additional drive bay in the slimline chassis is a tempting spot for a CD-ROM drive.

Despite the healthy maximum RAM, video acceleration, and built-in sound capabilities in the Deskpro/i series, despite the Windows capabilities, and despite the fact that both the ProLinea and the Deskpro/i models can run Windows, neither line has a system ideal for running demanding high-end apps.

The new systems are clearly being marketed as low-end and midrange systems, but you should still take note of the limitations of the designs, the components, and the expansion options when deciding if these systems meet your needs. The real attraction here is getting the Compaq nameplate at all-time low prices. All other issues aside, that alone should guarantee these machines at least moderate success.

• *List Price: ProLinea 3/25zs Model 40, under $1,000 with 2MB RAM, 40MB hard disk, 1.44MB floppy disk drive, Super VGA display system, two 16-bit expansion slots, 387SX coprocessor socket.*

Circle 432 on reader service card

• *List Price: Deskpro 3/33i and 4/33i Model 84, under $2,000 with 4MB RAM, 80MB hard disk, 1.44MB floppy disk drive, QVision accelerated Super VGA display system, three 16-bit expansion slots, 387SX coprocessor socket, built-in audio capabilities, and microphone. Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269; 800-345-1518; 713-370-0670.*

Circle 433 on reader service card

Benchmark Tests: Compaq ProLinea and Deskpro/i

Though processor, memory, and disk performance for Compaq's two new lines are not remarkable, the QVision technology included in the Deskpro/i series yields outstanding video results. The video benchmark test results for the 3/33i and the 4/33i are above average, and the WINMARK results are among the highest we have ever seen.

PC Magazine Labs' Hardware Performance Tests, Release 6.0, measure the PC's processor, memory, disk, and video subsystem performance. Tests were conducted with no disk cache. WINMARK results each represent the geometric mean of 11 WINBENCH graphics tests. Higher scores represent better performance

	Processor (operations per second)	Memory (kilobytes per second)	Disk (kilobytes per second)	Video (thousands of operations per second)	WINMARK
Compaq Deskpro 4/33i Model 84	349	5,949	86	4,890	16,165,693
Compaq Deskpro 3/33i	190	4,454	86	4,814	9,560,669
Compaq ProLinea 3/25zs Model 40	110	1,732	83	3,649	1,535,610

Approach

CONTINUED FROM PAGE 37

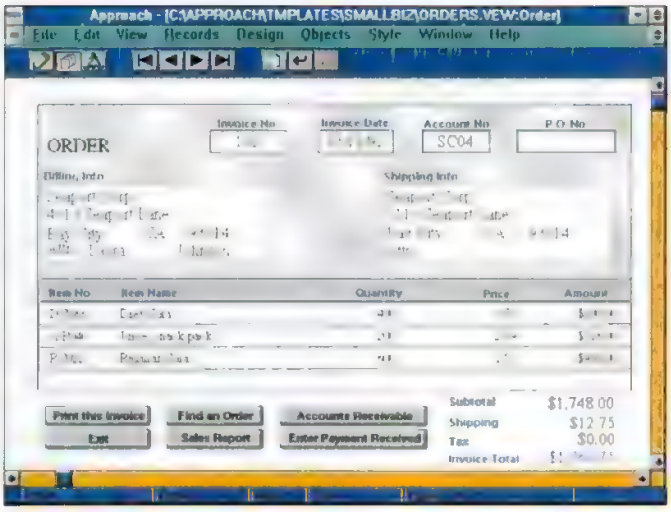
clicks of the mouse, and mix data from multiple formats in the same form or report. To use Approach on one of seven supported networks, just install it and let it run. Automatic record locking and password security are built in, so there's no need to purchase a network kit.

Approach wonderfully blurs the distinction between data entry and data display: You can enter data into both forms and reports. The same is true for using and designing a form or report. Just click on an icon to switch between browse mode for using a form or report and design mode for manipulating screen objects such as fields, graphics, and controls.

Like SuperBase, Approach offers VCR-like buttons as well as menus and keystrokes to help you navigate through a table. And like AceFile, Approach uses views to organize all the forms, reports, labels, and relationships you build between files. While the program uses Windows' Multiple Document Interface (MDI) to create multiple windows, it allows only one view per window. But you can switch between reports and forms of the same view in a single window.

FLEXIBLE FIELDS

Approach offers Boolean, date, memo, numeric, text, time, and picture fields, and lets you define calculated and formatted fields. It can automatically insert the date, time, predefined text, or a serial number from a sequence. There are also several ways to validate fields and to define calculated fields; calculated fields can be filled in by complex calculations based on other fields, tables, or a combination of some of the more than 80 functions and operators.



GRAPHIC TOOLS: *With Approach's built-in support for Windows controls, including buttons and combo boxes, it's surprisingly easy to build your own powerful front ends for simplifying data entry.*

An equal degree of flexibility applies to other components. For example, you don't have to stick to traditional data entry screens. With a few mouse clicks, you can substitute check boxes for Boolean fields, set up combo boxes for multi-entry fields, and create radio buttons for multiple-choice, single-selection fields. It can also display the child records in a one-to-many relation and build them right into a form.

COMPELLING REPORTS

Approach offers paint tools and visual programming tools similar to those found in Asymetrix Corp.'s ToolBook. You can design reports with colors and graphics—rectangles, circles, squares, and lines, as well as .BMP, .EPS, .PCX, TIFF, and .WMF files that you can resize to fit in a field. You can also add picture fields that users can fill in using freehand drawing tools.

There are other conveniences, too. You can specify which fields to index, or Approach will automatically create indexes for you on fields used in a query or a sort. In addition to traditional queries, you can query for a range of selections, perform case-insensitive searches, use wildcards, and even find empty fields. Approach will automatically return the subset of records found in a search, and it will let you manipulate and sort the result as if it were a new table.

BUSINESS TEMPLATES

Approach comes with plenty of sample database templates for businesses, helping you track budgets, prospects and leads, customers, employees, inventory, assets, orders, and payroll. There's even a time manager and conference-room scheduler. You can plug these in and customize them to fit your own needs.

You can also create keyboard macros and customize them to work with a specific form or report, find sets of records, sort them, execute menu commands, or run another macro. Other features include a sophisticated import/export facility that includes support for 1-2-3 and Excel files.

Approach's documentation is packed with screenshots, which makes it simple when it comes time to learn something new.

Right out of the box, Approach is compatible with Microsoft Windows for Pen Computing and offers full support for Windows' OLE (object linking and embedding). Though Approach's built-in font selection is weak, the package includes Adobe Type Manager 2.0, which provides more than enough font support.

There are a few problems with Approach: Icons are not always obvious, so you will have to look them up in order to be certain of what they do; most dialog boxes are not movable (this an annoyance when you need to see what's underneath them); and you can't tell which validation restraints are on which fields until you open the appropriate dialog box.

Still, Approach is the easiest to use and most comprehensive nonprogrammable database manager for Windows. You could wait for Borland, Microsoft, or Software Publishing to get their Windows database acts together. You could even wait for the arrival of the Windows version of the popular Macintosh database, FileMaker. Or you could get Approach today.

• *List Price: Approach for Windows, Version 1.0, $399. Requires: 2MB RAM (4MB recommended), 1.8MB hard disk space, Microsoft Windows 3.0 or later. Approach Software Corp., 311 Penobscot Dr., Redwood City, CA 94063; 800-277-7622, 415-306-7890; fax 415-368-5182.*

Circle 423 on reader service card

■ PCs

First Cyrix-Based PCs, from Tandon and Zeos, Redraw Price/Performance Curve

BY ALFRED POOR

First AMD took aim at Intel's dominance of the PC microprocessor market. And now we have Cyrix.

This spring, systems built around Cyrix's 486SLC processor have begun to appear. Somewhere between a 386SX and a 486SX (see the sidebar "Is the 486SLC a 386 or a 486?"), this 25-MHz chip offers a step toward 486SX performance in machines priced at the level of Intel 386SX–based systems. Do you dare not buy an Intel-based PC? Questions of compatibility always arise, but the first two 486SLC systems to arrive at PC Magazine Labs—the Tandon Option and the Zeos 486SLC-25—were fully compatible, and Zeos even guarantees its unit in writing.

TANDON OPTION

Tandon's Option machines feature a slimline case and removable processor cartridges. While designed with an ISA bus, the processor cartridges use a Micro Channel bus connector and a proprietary design to connect the CPU to the motherboard. The motherboard carries integral I/O ports—video, parallel, and two serial—as well as IDE hard disk and floppy disk controller ports.

There is a passive backplane rising from a single slot on the motherboard, which offers one 8-bit and six 16-bit slots, arranged on both sides of the backplane. The three 16-bit slots to the right can only accept half-length cards, but the four remaining slots on the left side can take full-length cards.

ROLL YOUR OWN: *The CPU cartridge in the Tandon Option is removable for easy upgrading.*

As its name implies, the Option is designed to be reconfigured. Tandon does not provide full system prices; you get to roll your own system. With 4MB of RAM and a 9,600-bit-per-second fax modem, the base unit sells for $993.82; with 2MB and a 2,400-bps data-only modem, the price drops to $798.71. Both come with 512K of video memory, DOS 5, Microsoft Windows 3.1, Microsoft Works for Windows, modem software, and a Prodigy start-up kit. A 14-inch color SVGA monitor lists for $338.74.

Hard disks come in a special removable format; insert a key in the front of the case, and the drive pops out of its bay. This is more of a security and upgrade feature than a portability feature; Tandon makes it clear that you need to handle the drives with care while they are out of the machine. There is a range of drive capacities and prices: 105MB, $372.77; 170MB, $569.91; 200MB, $798.84; 400MB, $1,337.86.

The real trick comes with the removable CPU cartridges. Tandon offers several, starting with a 386SX-25 with a list price of $179.92 up to a 486DX-50 for $1,476.91. The unit we tested came with a 386SX module, as well as the new $399.99 module based on the Cyrix 486SLC chip.

The 486SLC processor outperformed the 386SX processor in benchmark tests of processor operations and memory transfer. The 200MB hard disk turned in performance times better than the historical average for 25-MHz 386SX or 25-MHz 486SX systems. The Option also turned in an outstanding performance on the video operations benchmark tests, but the WINMARK test showed it to be considerably slower than the competition.

Tandon takes the path of least resistance when configuring the preinstalled Windows software: It chooses the VGA-resolution 640-by-480 mode with 256 colors, even though the system can handle 800-by-600 comfortably. Many users may not realize that they can get better resolution and may settle for the lower initial installation settings. And the case is unusually difficult to take apart. True, you can swap out the hard disk and CPU right through the front panel, but it is harder than it should be to change cards in a computer named Option.

• *Continues on page 42*

▪ Is the 486SLC a 386 or a 486?

by Christopher Barr

Cyrix's 486SLC is neither a 386 nor a 486. It's a hybrid, a cross between a 386SX and a 486SX.

Actually, the 486SLC is more like the 386SX because it operates at 32 bits internally and matches the 16-bit data path and pin-out of the 386SX. It's like a 486SX because it uses the 486SX instruction set, doesn't have a floating-point unit, and has an internal cache.

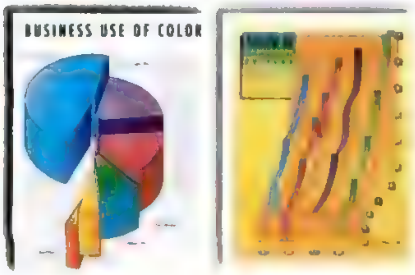
Unlike Intel's 486SX chip, which has an 8K cache, the 486SLC has a 1K cache. The fact that it is less than half the price of Intel's 25-MHz 486SX, however, makes that distinction easy to ignore.

Since it is pin-compatible with a 386SX, the 486SLC can easily be used in ordinary 386SX system designs and should provide about a 50 percent increase in performance compared with typical 386SX systems.

While the Cyrix 25-MHz 486SLC has a 24-bit address space, which means it can only address up to 16MB of RAM, two new versions announced by Cyrix—the 33-MHz and 40-MHz 486DLCs—equal Intel's 32-bit addressing space of up to 4 gigabytes of contiguous memory. This means that unlike the 486SLC, these new chips will be true Intel 486SX–compatibles.

The new HP PaintJet XL300 lets you make a splash without getting soaked.

At last. A printer with fantastic color and a brilliantly low price. $3,495.



©1992 Hewlett-Packard Company. *Suggested U.S. list price. Adobe and PostScript are registered trademarks of Adobe Systems, Inc. in the U.S. and other countries. †In Canada call 1-800-387-8667 Ext. 1150. PE12294

Vivid color has never been so affordable. Hewlett-Packard introduces the PaintJet XL300 inkjet printer. Now you can add a 300 dpi color printer to your system for the remarkably low price of just $3,495.*

The PaintJet XL300 has HP LaserJet printer compatibility built right in. The same typefaces. The same page formatting. It also has PC/Macintosh auto-switching, so users in a mixed environment can share. And, just like a LaserJet, the PaintJet XL300 becomes network-ready with optional HP JetDirect interface cards.

Get laser-quality text and graphics on a choice of media that includes plain paper and transparencies. Or add optional Adobe® PostScript® for access to even more graphics applications.

Now that there's a printer as practical as the PaintJet XL300, maybe it's time you took the plunge into color. Call **1-800-752-0900, Ext. 3159** for a free print sample and the name of the authorized HP dealer nearest you.†

HEWLETT PACKARD

CIRCLE 218 ON READER SERVICE CARD

Cyrix-based PCs

CONTINUED FROM PAGE 40

In spite of the Windows bundle, you are probably better off looking toward the Tandon as a slimline workstation. And with a total system list price of $2,531.39, the price is a bit steep for a souped-up 386SX. Given that many people don't upgrade their computers that much in the first place, you may be paying more of a premium for the options in the Option than they may be worth to you.

ZEOS 486SLC-25

The Zeos 486SLC-25 takes a very different tack than the Tandon Option. Instead of trying to be a modular bag of tricks, the Zeos system is a straightforward, full-size business machine with all the trimmings.

The full-height case looks much like any AT-style desktop system, with LED indicators, turbo and reset buttons, and a stack of drive bay openings. The power switch is conveniently located on the front panel.

Inside, the motherboard looks typical. That's hardly surprising, since the design is based on the Zeos 386SX motherboard, modified slightly for the Cyrix chip. About the only evidence we could find of last-minute changes was three short wire traces added in the vicinity of the CPU socket.

The motherboard has one 8-bit and seven 16-bit sockets; only one was occupied, and it contained the Diamond Stealth HiColor SVGA adapter. The 8-bit slot is obstructed, and two of the 16-bit slots cannot take full-length cards since they would collide with the SIMMs. Otherwise there is plenty of room for expansion. There are two serial ports, a parallel port, an IDE hard disk, and floppy ports on the motherboard.

WHAT'S INSIDE? *The Cyrix chip in the Zeos 486SLC-25 delivers fast performance at 386SX price.*

The system comes with high-density format floppy disk drives (1.2MB and 1.44MB) as well as a 107MB hard disk. This configuration leaves one half-height bay open through the case plus four additional half-height internal bays (one for a 3.5-inch device), though there are only three available power connectors.

The full complement of hardware is matched by the software offerings. The system comes with DOS 5.0, Windows 3.1, and a Microsoft mouse, plus your pick of two of the following: 1-2-3 for Windows, Ami Pro 2.0, or Freelance for Windows. The base model comes with a Diamond SpeedStar HiColor video adapter to go with the 1,024-by-768 resolution noninterlaced color monitor. All this carries a price of $1,995. The Diamond Stealth card supplied with our evaluation unit is a $100 upgrade over the base system.

In terms of CPU and memory performance, the Zeos 486SLC-25 performed about the same as the Tandon 486SLC–equipped model. The hard disk performance was only slightly slower than the Tandon. Although the video performance was slower than the average for 25-MHz 486SX machines, it was considerably faster than the historical average for 25-MHz 386SX systems. And thanks to the video accelerator in the Stealth card, the Zeos sped through the WINMARK test.

Zeos has priced this system at the same point as its 25-MHz 386SX systems. And if buyers have any hesitation about buying a non-Intel chip, Zeos has a policy that effectively removes all doubt: If you find any compatibility problems with any of the 100 top-selling software programs, Zeos will replace the entire system with a comparably equipped Intel 486SX system.

If you are looking for more than a 386SX but less than a full-blown 386DX or better, the Zeos gives you all you need for Windows operation, including a healthy library of software to get you started.

• *List Price: Tandon Option with Cyrix 486SLC processor module, 8MB RAM, 200MB hard disk, 512K SVGA adapter (on motherboard), 800-by-600 resolution color SVGA monitor, DOS 5.0, Windows 3.1, Works for Windows, WinFax, $2,531.39. Tandon Corp., 405 Science Dr., Moorpark, CA 93021; 800-826-3660, 805-378-7888.*

Circle 426 on reader service card

• *List Price: Zeos 486SLC-25 with 4MB RAM, 107MB hard disk, 1MB Diamond SpeedStar HiColor SVGA adapter, 1,024-by-768 resolution noninterlaced color monitor, DOS 5.0, Windows 3.1, choice of two of three packages (1-2-3 for Windows, Ami Pro 2.0, Freelance for Windows), $1,995. (Diamond Stealth HiColor adapter $100 additional.) Zeos International Ltd., 530 Fifth Ave. NW, St. Paul, MN 55112; 800-423-5891, 612-633-4591; fax 612-633-1325.*

Circle 427 on reader service card

Benchmark Tests: Cyrix 486SLC-based PCs

The Cyrix 486SLC performs as it should, bringing better-than-386SX/SL speed to near-386SX prices. As expected, both the Tandon Option 486SLC and the Zeos 486SLC-25 results landed squarely between the average 25-MHz 386SX and the average 25-MHz 486SX system in processor and memory testing.

PC Magazine Labs' Hardware Performance Tests, Release 6.0, measure the PC's processor, memory, disk, and video subsystem performance. The WINMARK result represents the geometric mean of 11 WINBENCH graphics tests. Higher scores represent better performance.

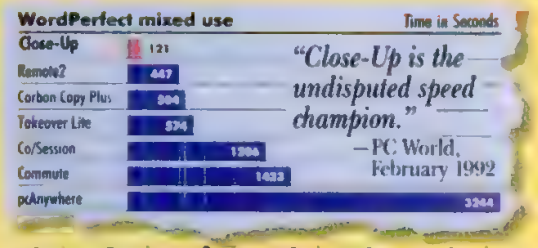
	Processor (operations per second)	Memory (kilobytes per second)	Disk (kilobytes per second)	Video (thousands of operations per second)	WINMARK
25-MHz 486SX historical average	265	4,647	91	2,165	2,416,779
Tandon Option with 25-MHz 486SLC processor	184	2,988	105	3,447	287,636
Zeos 486SLC-25	178	3,012	82	1,936	5,667,367
25-MHz 386SX/SL historical average	120	2,381	91	1,195	1,116,587
Tandon Option with 25-MHz 386SX processor	113	2,194	95	3,502	176,772

Close-Up Wins Remote Honors

PC WORLD

Close-Up is fast, easy to use, and reliable. What else do you need in a remote package?

Close-Up Dual Pack 4.0 earns its Best Buy by virtue of lightning speed, an easy interface, reliable error handling, and a complete set of tools for controlling one computer from another and collaborating with a partner. It's also the only package that can run Windows reliably from afar—even in extended mode. Runner-up **Remote2** isn't quite as fast, and its toolbox is smaller, but it is perfectly dependable with graphics.



"Close-Up is the undisputed speed champion." —PC World, February 1992

Excellent ★★★★
Good ★★★
Fair ★★
Poor ★

Carbon Copy Plus 6.0	671	★★½	★★½	★★	★★★½	★★½	★★	★★★½	★★½
Central Point Commute 1.1	673	★½	★½	★★	★★	★★	½	★★★★	★★
Close-Up Dual Pack 4.0	[illegible]	★★★★	★★★★	★★★★	★★★★	[illegible]	★★★	★★★	★★★★
CO/Session 6.0	674	★★★½	★★½	★½	★★	★★★½	★½	★★★½	★★½
pcAnywhere 4.03c	675	½	★★	★½	★★★★	★★	★	★★★½	★½
Remote2 2.1	676	★★★	★★★★	★★½	★★½	★★★½	★★½	★★★½	★★★
Takeover Lite 2.0	677	★½	★½	★★	★★★	★★★	★★★	★★★½	★★

Overall value is calculated by multiplying each category rating by the category's weight percentage, summing the results, and rounding to the nearest half number

Actual test results reprinted from PC World's Review of Remote Communications Software, February 1992.

Now Supports Both Windows & DOS

Remote Performance: Why Close-Up is Best

- *Supports both Windows and DOS with the same program.*
- *Fastest VGA, EGA and CGA graphics.*
- *Fastest file transfers and remote screens.*
- *Runs Windows in all 3 modes. No restrictions.*
- *Runs multiple Windows and DOS applications simultaneously, full-screen or windowed.*
- *Remote mouse and keyboard control.*
- *Self-installing, fully-automated for fast, easy operation.*

Call for FREE Working Model

"Close-Up...The Best Program You Can Buy for Remote Control"

—Reprinted from PC Magazine, January 14, 1992

The Ultimate Remote Program

"Norton-Lambert's Close-Up is the fastest, easiest, and the most reliable program we looked at..." —PC World, February 1992

The results are in and the experts agree. New Close-Up 4.0 has proven time and again to be the most advanced remote control system available.

Close-Up lets you view & control PCs miles away *by modem.* Now with full support for Windows, DOS, graphics and mice at record-breaking speeds, Close-Up is the fastest, easiest way to handle all your remote communications needs.

What You Can Do:

- ✔ Take control of PCs at any location.
- ✔ Work remotely on the road via laptop.
- ✔ Control your office PC from home.
- ✔ Access your company's branch offices.
- ✔ Train your associates on any application.
- ✔ Help customers miles away, remotely.
- ✔ Transfer text, data, any file between PCs.
- ✔ Remotely install and run Windows.
- ✔ Automate remote operations at night.
- ✔ Access networks all over the world.

Winner of the Top Awards

"Close-Up has been highly polished and it's flexibility and capability clearly make it the best program you can buy for remote control."
—PC Magazine "Best of 1991," January 14, 1992

"If you're serious about going remote, check out Close-Up. The program's handling of Windows is simply dazzling."
—PC World "Best Buy," February 1992

"Close-Up is one of the fastest products we've seen. It had the fastest file transfer times and the shortest times redrawing the screens."
—LAN Times, November 18, 1991

"You will not find a better all-around remote-control program."
—PC Magazine "Editors' Choice," February 25, 1992

Control both Windows and DOS with just one program

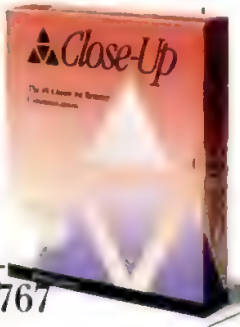
Now with double the remote power, Close-Up gives you full support of *both* Windows and DOS. That's like getting two remote programs for the price of one!

Spectacular Savings!

Now you can receive the Close-Up 4.0 Dual Pack including both sides for only $199—you save $240!

Upgrade Now!

Upgrade your current remote program to new Close-Up 4.0. Call for special pricing.



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CIRCLE 028 ON READER SERVICE CARD

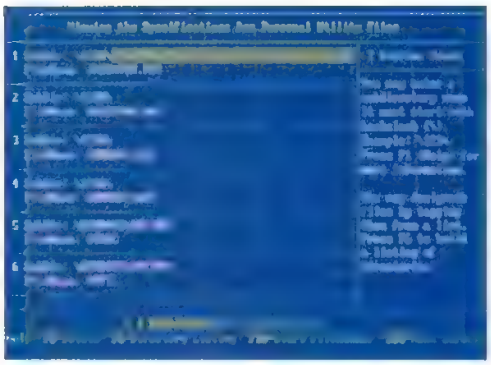
Utilities

FileRunner Gets Your Desktop And Laptop In Sync

BY BRUCE BROWN

If you use a desktop system in the office and a laptop while traveling, you're well aware of the frustrations of keeping files on both machines synchronized and up-to-date. You're also a good candidate for FileRunner, the $99.95 file transfer program from MBS Technologies that uses floppy disks to update and match files on any number of PCs, so you can be sure you're working with the most current versions of all your important files. And you won't see a cable anywhere in the vicinity.

After installing FileRunner on the computers you want to synchronize, you create a FileRunner floppy disk, called a Runner, that has a configuration file listing specific subdirectories and files to match up as well as a directory-viewing feature.



FileRunner's configuration screen lets you select subdirectories and filenames to synchronize on multiple computers.

To synchronize files, you start FileRunner and select File Transfer. The program checks the floppy and hard disks and reports which drive holds the updated files. An overwrite protection feature warns you if you attempt to replace a file with an earlier version. An optional file-compression routine and virus scanner will kick in automatically during file transfer. You're then ready to carry the Runner to your other PC and let FileRunner update the files.

One of FileRunner's limitations is a maximum of 200 files per floppy disk, and it doesn't automatically let you continue on a second floppy disk. It's also vital that you configure multiple PCs with identical subdirectory structures and filenames.

There's no magic to FileRunner. If you had the time and patience, you could set up the same facilities using DOS batch files and available shareware. But FileRunner can save you plenty of time and aggravation when you need the right file in the right place at the right time.

• *List Price: FileRunner, Version 1.4, $99.95. Requires: 512K RAM, DOS 3.1 or later. MBS Technologies Inc., 4017 Washington Rd., McMurray, PA 15317; 800-860-8700, 412-941-9076.*

Circle 419 on reader service card

Windows

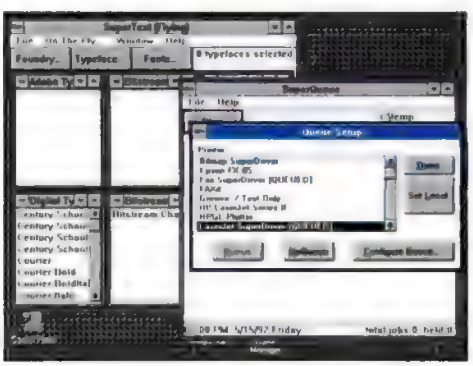
Faster Text Printing Keeps SuperPrint Ahead of the Game

BY ROCK MILLER

Microsoft may have fixed Windows' deficiencies in font support and print performance, but Zenographics is still a jump ahead. SuperPrint 2.2 maintains the edge it needs to tempt your enhancement dollar with faster text printing, better font support, rock-solid background spooling, and comprehensive image enhancement. Better yet, it now costs less: $149 versus $199.

As always, SuperPrint allows you to mix and match on the fly screen and printer fonts from all major formats—including Windows 3.1's native TrueType—or output on LaserJet-compatible, ink jet, and dot matrix printers. But its newfound ability to download text to your LaserJet as compressed soft fonts eliminates its biggest former drawback: sluggish text printing. Not only does it slightly improve on TrueType alone, it works with Adobe Type Manager to produce significant gains in PostScript text printing speed.

But SuperPrint's forte is still in graphics printing. With complex pages, large vector graphics, and bitmaps, SuperPrint is dramatically faster than standard Windows drivers. And it now includes color and gray-scale image correction, a bitmap driver, and a fax driver.



SuperPrint manages font formats and replaces Windows' Print Manager.

SuperPrint's best feature is Superqueue, a replacement for the Windows Print Manager. It now manages background printing from any Windows device, multiple queues, and job delays for batch or remote printing.

SuperPrint 2.2 retains a few annoyances: Memory-cached screen fonts scroll a bit sluggishly, on-screen renderings of PostScript fonts are spidery, and printed text has different leading than that produced by ATM. But you can work around these faults. SuperPrint is still a good addition to your Windows toolkit.

• *List Price: SuperPrint, Version 2.2, $149; upgrade, $39. Requires: Microsoft Windows 3.0 or later. Zenographics Inc., 4 Executive Circle, Irvine, CA 92714; 800-366-7494, 714-851-6352.*

Circle 420 on reader service card

Gain Without Pain.

Solve memory problems
QEMM 386 makes the most of every last 'K'. DESQview uses that memory to run multiple programs.

Multitask
Run multiple programs side-by-side in windows. 'Background' programs can continue to run.

See text and graphics side-by-side
Reference information in your graphics program while writing your report

Run Windows programs
DESQview even lets you run Microsoft Windows 3.0 and 3.1.

Easy menu access to programs and DOS services
Access programs or DOS in a window with just a few keystrokes or mouse clicks. It's that simple.

See multiple files
If your programs allow it, DESQview lets you run the same program in two or more windows. Great for comparing files

Cut and paste data
Transfer data between programs with a few keystrokes.

Handle large programs
Run standard DOS programs side-by-side with DOS-extended programs like 1-2-3 Release 3.

DESQview. The Efficient Multitasking, Windowing Environment.

After all the hoopla surrounding the latest version of Microsoft Windows, fully 85% of PC users still haven't bought into it.

While there are some exciting new Windows applications, MS-Windows' huge RAM and disk space requirements make it too big a trade-off in expense and performance for users of DOS programs to run it constantly.

Multitasking and windowing DOS programs is still much easier to accomplish with DESQview.

DESQview 386 v2.4 lets you use your favorite DOS and DOS-extended programs in windows side-by-side on 386SX, 80386 and i486 PCs. As you can see above, you can even run Microsoft Windows within DESQview. (The new QEMM-386 that comes with DESQview 386 v2.4 assures that all programs and environments get the maximum memory they need to run more efficiently.)

DESQview v2.4 gives older 8088, 8086 and 286 PCs with additional memory most of the same capabilities with surprisingly little performance trade-off.

Whatever programs you use—DOS, extended DOS or Windows—and whatever hardware you have, 8088 or i486 or something in between, there's a DESQview to get the most out of the hardware and software you own today.

Quarterdeck

Quarterdeck Office Systems, 150 Pico Boulevard, Santa Monica, CA 90405 (310) 392-9851 Fax (310) 399-3802
Quarterdeck International Ltd., B.I.M. House, Crofton Terrace, Dun Laoghaire Co. Dublin, Ireland Tel.(353) (1) 284-1444 Fax: (353) (1) 284-4380

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CIRCLE 338 ON READER SERVICE CARD

■ Utilities

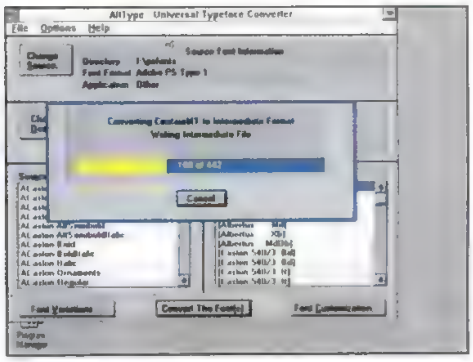
AllType Font Converter: Can the Quality Match the Convenience?

BY EDWARD MENDELSON

You can buy printer fonts for the PC in almost a dozen font formats, but you can't always get the font you want in the format that your application supports. Atech Software's $79.95 AllType 2.0 is designed to solve that problem. It converts fonts among most major scalable formats, although most users will want it for its ability to convert fonts into Windows 3.1's native TrueType format. But no matter how much you want TrueType or any other kind of font, you'll find AllType useful only if you can accept the inevitable loss of quality caused by conversions between font formats.

The package includes both a Windows and a DOS version. Both produce identical results and install converted fonts into Windows; the DOS version also installs into the DOS versions of WordPerfect, Microsoft Word, and Ventura Publisher. You can convert fonts between any combination of the TrueType and PostScript Type 1 and Type 3 formats, LaserJet III PCL 5 soft fonts, the Intellifont format used by HP's Type Director, and Nimbus Q and Atech's proprietary format. You can convert Bitstream Fontware outlines only if you use Fontware to generate Type 3 outlines and then use AllType to convert those.

AllType would be marvelous if it worked perfectly, but it is mathematically impossible to make exact conversions between PC font formats. AllType's output is good enough to satisfy most users, but experienced eyes will see that the converted fonts tend to exaggerate smaller features in the source design. The exaggerations get worse at small sizes. Serifs that are small and subtle in the original often emerge as large and distorted in the conversion. Gentle curves become bulbous.



CONVERSION: *AllType converts fonts into a proprietary format before converting them into the chosen output format.*

When generating fonts, the converter applies hints (instructions that improve quality on low-resolution devices), but these hints apparently apply only to the entire font and lack the subtler instructions that can be manually applied to individual characters in high-quality commercial fonts.

Before using AllType, ask if the convenience of a converted font outweighs the loss of quality. Windows lets you work with multiple font formats at the same time by running Adobe Type Manager (for Type 1 fonts), HP's Intellifont for Windows (for PCL 5 fonts printed to a LaserJet III), or Bitstream's FaceLift (for Speedo and Type 1 formats). But DOS applications are less friendly, and none allows you to mix formats. If you need converted fonts, AllType is the product that converts more formats than any other.

• *List Price: AllType, Version 2.0, $79.95. Requires: 640K RAM, DOS 3.1 or later; Windows version requires Microsoft Windows 3.0 or later. Atech Software, 5964 La Place Ct., #125, Carlsbad, CA 92008; 800-786-3668.*

Circle 418 on reader serice card

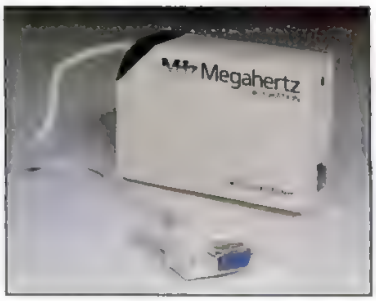
■ Communications

Megahertz Portable Modem Proves Good Choice for 9,600-bps Faxing

BY JOE SALEMI

Megahertz Corp., long known for its portable modems, has joined the small but growing group of vendors of portable 9,600-bps V.32 modems. At $669, the P296FMV Pocket FAX/Modem is in the same price range as most of its competitors, but it adds a feature not yet common in V.32 modems: support for sending and receiving Group III faxes.

At 1 by 2.25 by 3.25 inches, the P296FMV is only slightly larger than a pack of cigarettes. It weighs a little over 6 ounces with the two AA batteries it uses for power installed. (Megahertz claims a usable battery life of 4.5 hours when alkaline cells are used.) A 5-ounce external power supply is included, as is a soft carrying case that holds the modem and phone cord. The modem has an attached 9-inch serial cable that ends in a 9-pin RS-232 connector.



TALK TO ME: *The $669 P296FMV Fax/Modem weighs 6 ounces.*

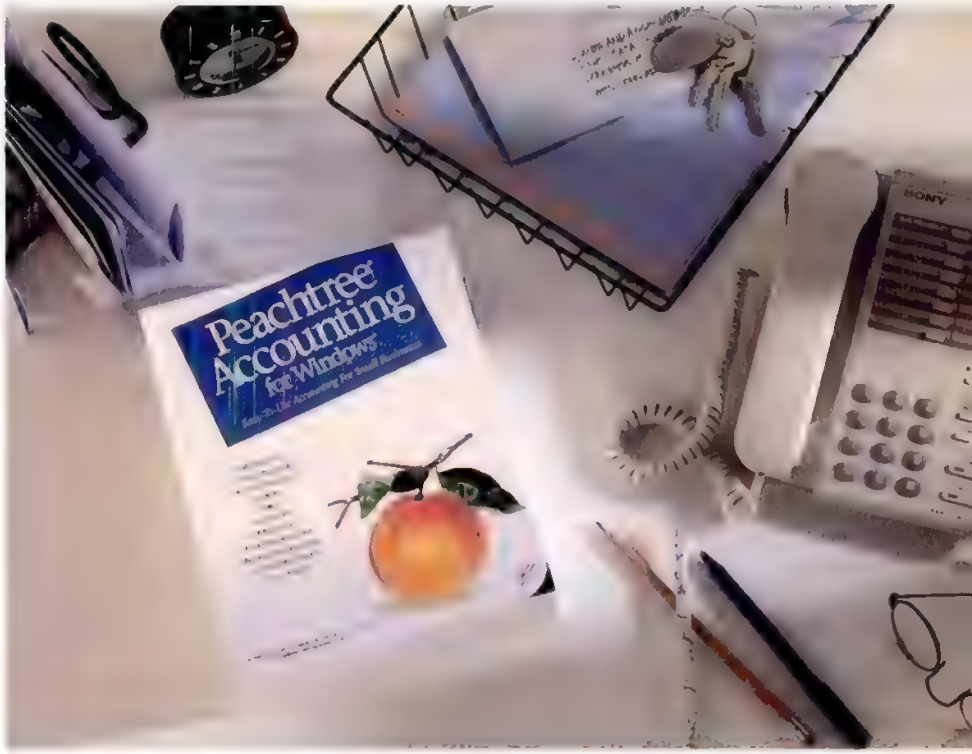
There are no status lights on the P296FMV; the only indications of call progress come from a speaker and modem responses to the comm program. It's based on the AT&T V.32 chip set and uses the standard Hayes AT command set with Microcom ("\" command) extensions. Reliable V.42 or MNP connections are indicated by the addition of "/REL" to the modem's connection responses.

The modem has support for Class 1 fax modem codes and will work with any program that includes Class 1 drivers, such as WinFax PRO and Quicklink II. Megahertz

• *Continues on page 48*

Now The People Who Pioneered PC Accounting Offer Full-Featured Windows Accounting For Only $99.

At Peachtree, we've been helping small businesses get their accounting done – quickly and easily – for over 16 years. Now we're taking that tradition one step further.



New Peachtree Accounting for Windows™. Not Just A Better Program. A Better Value.

Peachtree Accounting for Windows is an exciting new update of Crystal Accounting, the first accounting system to take advantage of Windows.

ASK YOUR ACCOUNTANT

It introduces a host of new features that make excellent use of Windows' graphical user interface. Plus, it sports the special price of only $99 – making it by far the best value in Windows accounting.

You'll find all the functions your business needs – General Ledger, Budgeting, Accounts Receivable, Invoicing, Accounts Payable, Payroll, Inventory, Job Costing, and Bank Reconciliation – in one easy-to-use program.

The package includes a Financial Report Writer for customizing your financial statements, and a Custom Forms Generator for designing your own invoices and statements.

On-line help is always available, as well as a complete accounting primer and tutorial. Plus, Accounting for Windows is multi-user capable and fully networkable – right out of the box.

Rave Reviews.

PC Week said our Windows program was "well-designed and well-implemented . . . anyone with limited PC or bookkeeping experience should be able to learn the program quickly." And *PC World* says, "if you're looking for a balance between power and simplicity, this is the program to buy."

More Accountants Recommend Peachtree To Their Clients.

More accountants recommend Peachtree than any other brand of PC accounting software.

Maybe it's because we're the people who invented PC accounting in the first place. Or because we've sold nearly half a million software packages worldwide. Or because nobody works harder to bring you the best value in accounting software.

What's more, we guarantee your satisfaction – and back it up with a 60-day money-back guarantee. So save time and make your money go further. Get new Peachtree Accounting for Windows. See your local dealer or call PeachLine at (800) 428-9973.

Peachtree®

The first name in small business accounting software.™

PEACHLINE. There's no way we could squeeze all the features of Peachtree® Accounting for Windows™ into one ad. But if you'd like to talk with one of our people about your specific needs, or you'd just like a free catalog, call PeachLine at (800) 428-9973.

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CIRCLE 358 ON READER SERVICE CARD

Pocket Modem

CONTINUED FROM PAGE 46

includes a copy of MagicSoft's MTEZ with ExpressFax, a comm program that also sends and receives Group III faxes at 9,600 bps.

Internal versions of the P296FMV for AST, Toshiba, and Zenith notebook systems are also available at a list price of $699; the internal Compaq version costs $669.

RELIABLE CONNECTIONS

The modem had no problems connecting with other V.32 modems at 9,600 bps and successfully negotiated V.42/V.42bis connections on services that supported them. It also connected with 2,400-bps modems, with or without V.42/V.42bis or MNP 4 or 5 support, with few problems. We did notice that the modem seemed to take longer than other modems to resynchronize with the other end when it encountered line noise. This had some effect on file transfers and ASCII text downloads; the character-per-second rate dropped by about 30 percent, and there were noticeable pauses as the text scrolled across the screen.

The Megahertz P296FMV comes with a 5-year warranty and is a good buy if you need both fax and V.32 capabilities for your notebook. But if all you need is standard V.32 communications, Telebit's $599 QBlazer modem would be a better choice.

• *List Price: P296FMV Pocket FAX/Modem, $669. Requires: 9-pin serial port, DOS 2.0 or later, two AA batteries; 512K RAM required for METZ communications software. Megahertz Corp., 4505 S. Wasatch Blvd., Salt Lake City, UT 84124; 800-527-8677, 801-272-6000.*

Circle 417 on reader serice card

Windows

hDC Power Launcher 2.0 Adds Action Editor and Power Bar

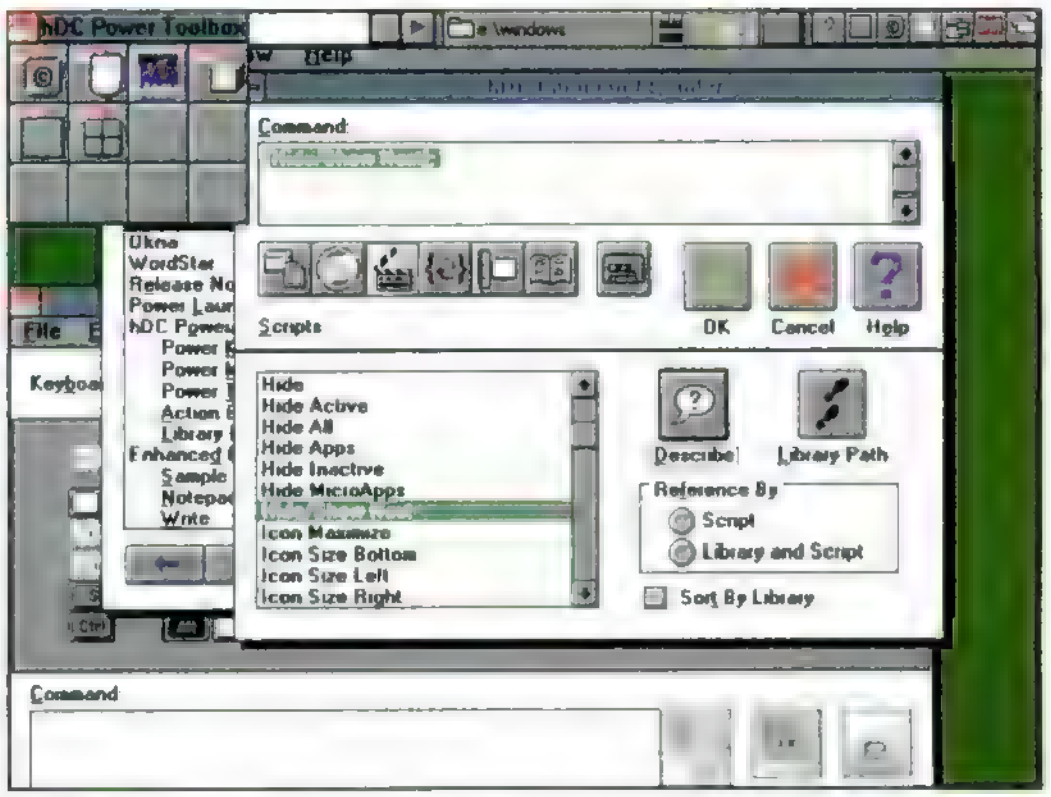
BY BARRY BRENESAL

Using Windows to start up applications is fine, but using hDC Power Launcher is like being at mission control.

Power Launcher, Version 2.0 ($99.95), is an interface that augments Windows with impressive utilities. Give Power Launcher just 20K of memory and you can create menus that recall commands, add keyboard macros, run programs where and when you want, and remap keystrokes and mouse actions to specific applications.

The new version of Power Launcher also takes advantage of Microsoft Windows 3.1 features. The most familiar of these is drag-and-drop, with its Mac-like ability to treat icons as files and to launch tasks behind the scenes. For example, with the built-in Enhanced Command set, you can create a Power Tool that reformats text, sends it via e-mail, downloads and reformats incoming messages, and displays them on-screen in your word processor—all transparently. Your Power Tools are collected in the Power Toolbox, which is a floating panel of user-defined applications that you can customize to provide far more functionality than simple drag-and-drop, copy, print, and delete actions.

The more complex Enhanced Commands are not easy to learn and the documentation is both terse and technical, but there's no denying that drag-and-drop acquires exponential power when you can perform multiple activities involving scripts, macros, DOS commands, DDE (dynamic data exchange)—all with a single movement of the mouse.



NEW TOOLS: *At the top of this Power Launcher 2.0 screen is the new Power Bar, which includes a command line.*

SHOW ME OLE

Windows 3.1's implementation of OLE (object linking and embedding) supplies the substructure for Power Launcher's new Action Editor. Brief demonstrations of how to use Windows' compound document creation procedures with hDC's Enhanced Commands can be found in the new on-line tutorial. The Show Me! icon demonstrates Power Launcher's Virtual Desktop Map by loading several Windows applications and then moving each to its own, separate desktop.

Another major addition is the Power Bar, which replaces the largely unused Windows title bar and displays a graphical memory chart, current directory listing, customizable buttons, and a command line for directly entering Enhanced Commands. Of course, you can still click on the hDC icon in the upper-left corner to access application menus and hDC utilities quickly.

Little that Power Launcher 2.0 offers is new under the Windows sun: You'll find floating "power toolboxes" in the shareware program Appbar and a virtual desktop map and drag-and-drop features in Tool Technology's innovative WinTools. But Power Launcher provides these functions and more under a seamless, efficient interface. For ease of use, low resource consumption, and one-stop functionality, it can't be beat.

• *List Price: hDC Power Launcher, Version 2.0, $99.95. Requires: 2MB hard disk space, Microsoft Windows 3.0 or later. hDC Computer Corp., 6742 185th Ave. NE, Redmond, WA 98052; 206-885-5550.*

Circle 421 on reader service card

Can You Spot The Winner?

way 2000
The Winners Circle

Gateway 2000 employees were photographed for the summer fun ad at Atokad Park in South Sioux City, Nebraska.

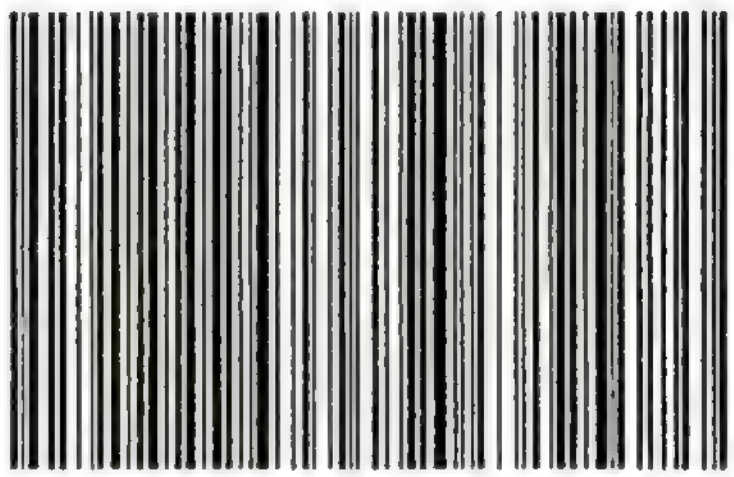
Back

1. Follow instructions on the other side

Inverted Back

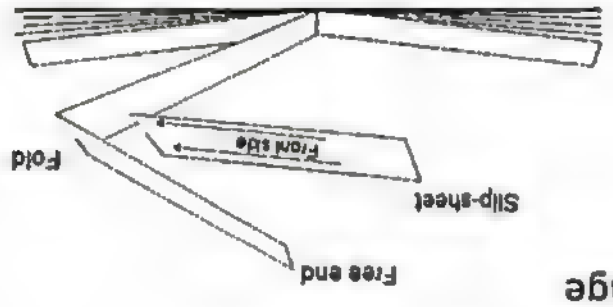
1. Follow instructions on the other side

Folded edge of the page



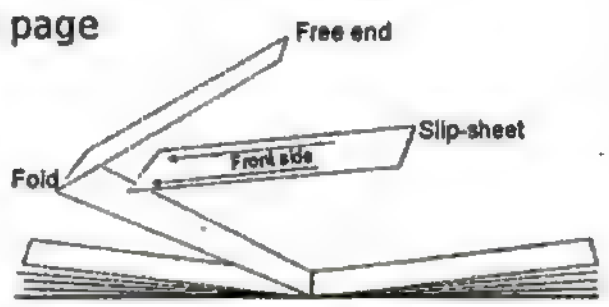
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

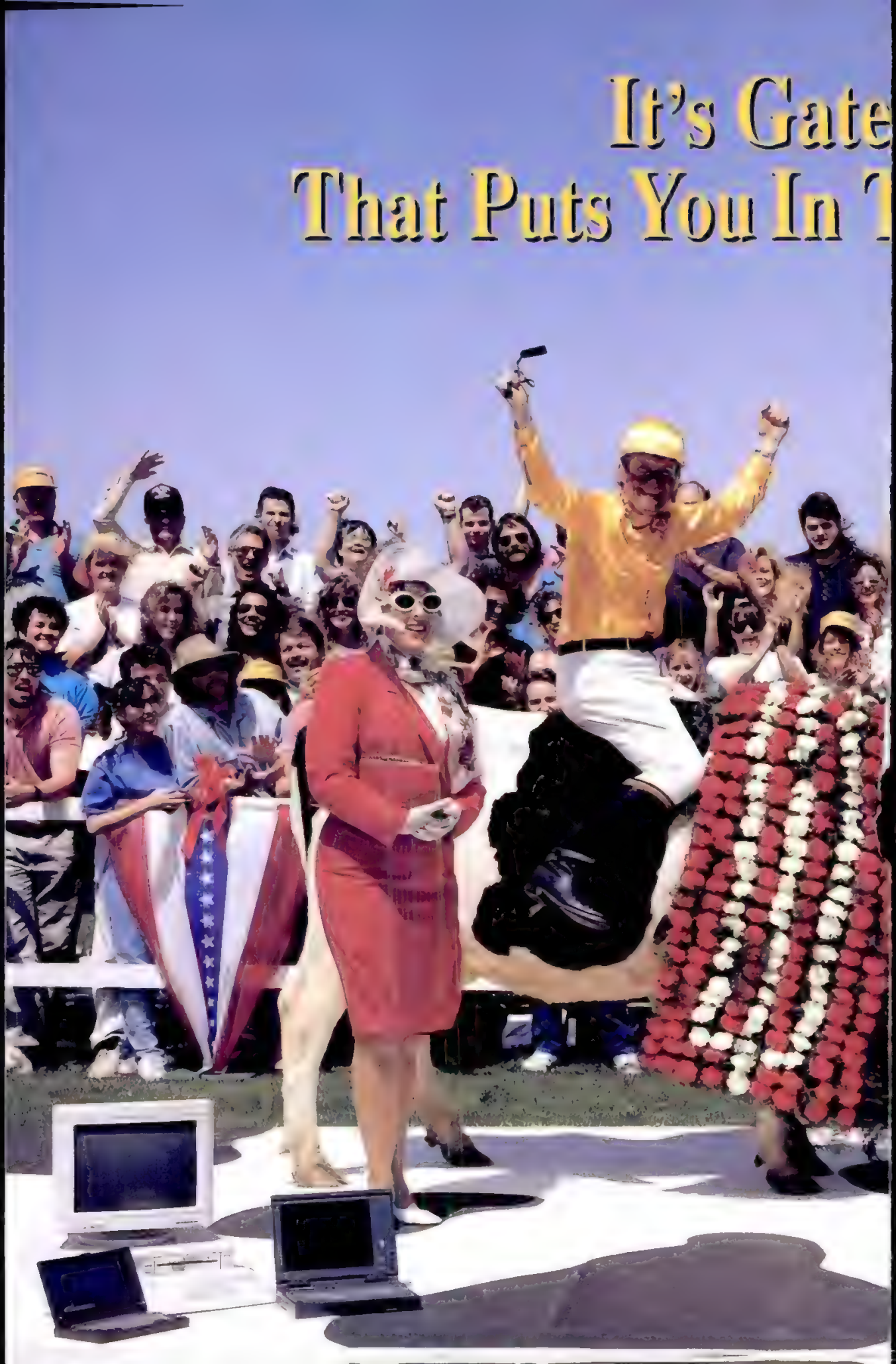


Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



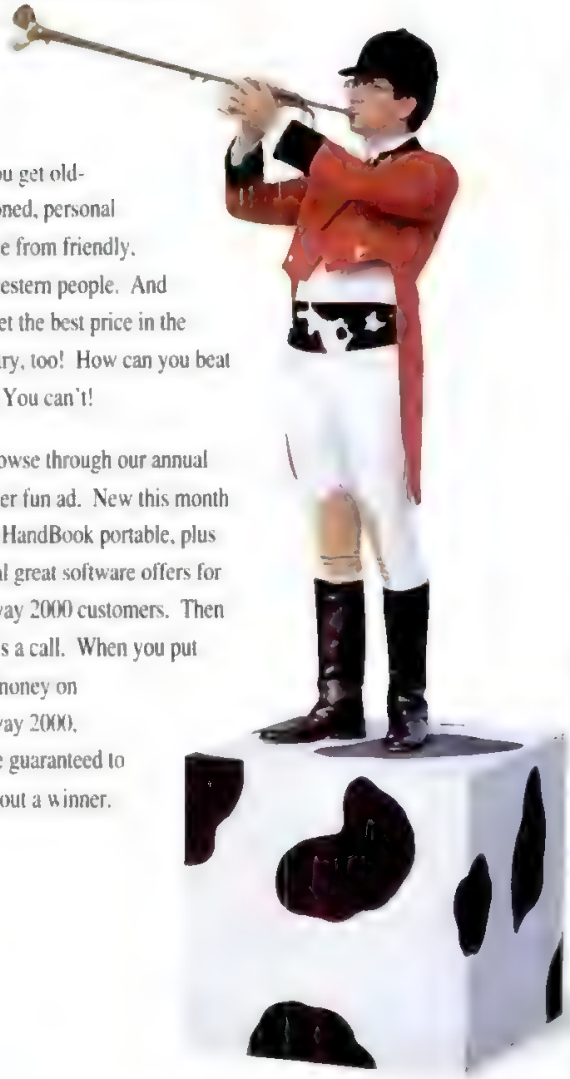
It's Gate
That Puts You In T



The Choice Is Black & White!

The results are final — all those thoroughbred "favorites" outdistanced by a simple, determined, black-and-white cow.

There's a big payoff for you if you picked Gateway 2000. You get a quality, high-performance system with the number-one customer satisfaction and reliability ratings in the industry, according to *PC Magazine* readers in the 1992 service and reliability survey.

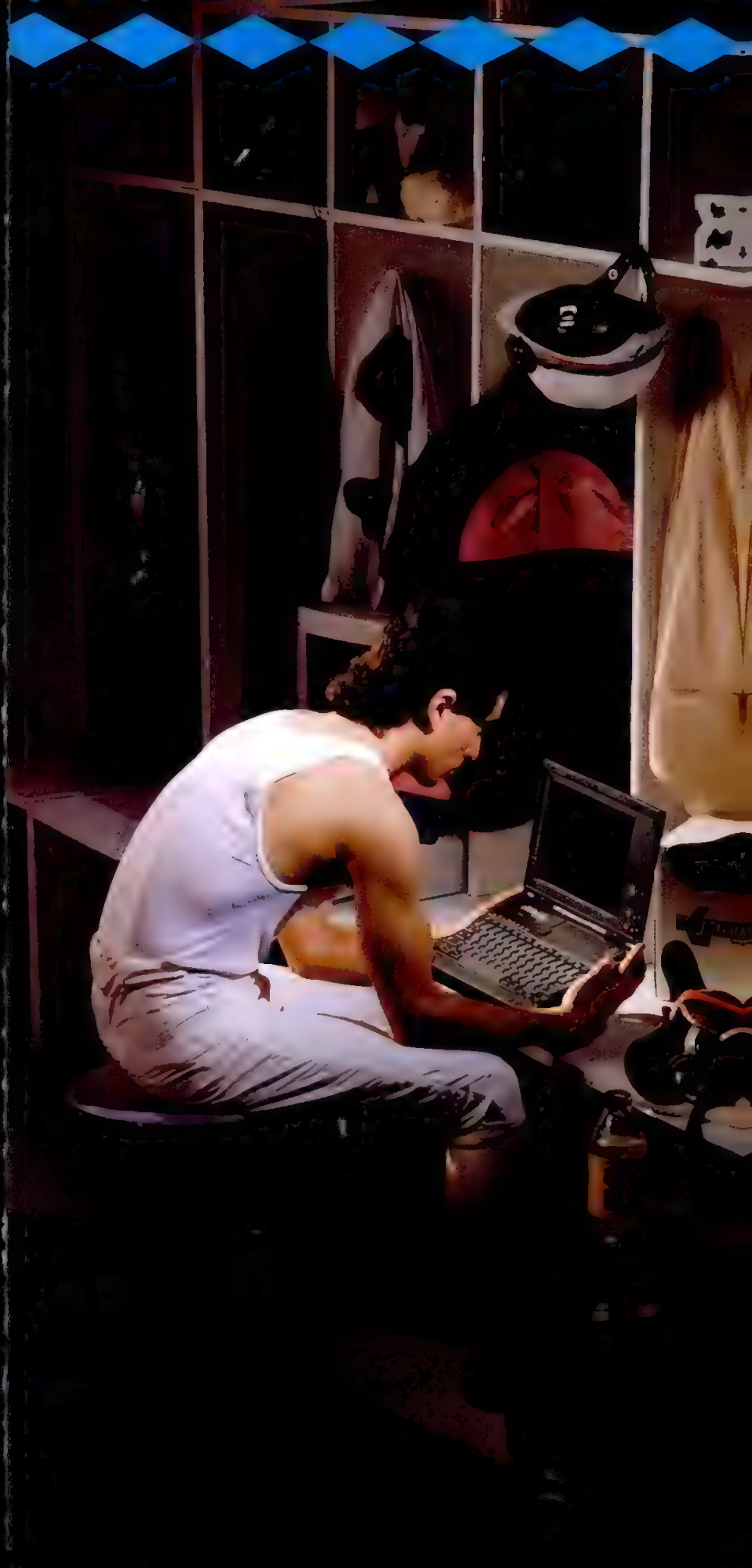


You get old-fashioned, personal service from friendly, Midwestern people. And you get the best price in the industry, too! How can you beat that? You can't!

Browse through our annual summer fun ad. New this month is our HandBook portable, plus several great software offers for Gateway 2000 customers. Then give us a call. When you put your money on Gateway 2000, you're guaranteed to come out a winner.

GATEWAY 2000

"You've got a friend in the business."



GATEWAY 2000 NOTEBOOKS PUT YOU IN RACING FORM

The Nomad Series

Our small, lightweight Nomad notebook computers let you take desktop computer performance anywhere you go. Nomad models come with VGA graphics, a FieldMouse™ (portable pointing device), built-in floppy drive, and an 80 or 120MB hard drive, depending on the model. A patented power-management system gives you hard-to-beat battery life benchmarks — over six hours of operation from a single battery on the 25MHz 486DX system!

The Nomads have a bright, crisp, backlit, 10-inch triple supertwist VGA screen — resolution is 640 x 480, 64 gray scale, on the LCD. With simultaneous video, you can also display on an external monitor.

All these features ... and the Nomads are made in the U.S.A.!

Nomad 325SXL $1995

25MHz, 386SXL processor ■ 2MB RAM ■ 80MB hard drive

Nomad 420SXL ■ $2795

20MHz, Intel® 486SXLP processor ■ 4MB RAM ■ 80MB hard drive

Nomad 425DXL ■ $3495

25MHz, Intel 486DXLP processor ■ 4MB RAM ■ 120MB hard drive

For The Power User On The Go

Nomad Combo ■ $3995

Since the Nomad 425DXL has all the power of a 486DX desktop system, it's the ideal portable/desktop combination system! Save with this combo package!

Combo Highlights: Nomad 425DXL ■ 15" CrystalScan 1572FS color monitor ■ programmable 124-key AnyKey™ keyboard

The HandBook™

If you like to travel light, you can't go wrong with the HandBook. It weighs only 2.75 pounds and measures roughly 6 x 9 inches — smaller than this magazine! Yet it has 286-class performance and real PC features including a bright, backlit screen, a bonafide 40MB hard drive and a comfortable keyboard (no chiclet keys). Downloading information from your HandBook to your office computer is easy with the serial cable and file transfer software provided.

HandBook ■ $1295

For The Executive On The Go

HandBook Combo ■ $3995

Combine the portability of our HandBook with the power of our 33MHz 486 desktop system with communication capabilities — and you have a terrific combo, Gateway value-priced!

Combo Highlights: HandBook with 2,400 bps external modem and communication software ■ 33MHz 486DX system with 120MB IDE hard drive ■ TelePath™ fax/modem package

GATEWAY2000

"You've got a friend in the business."

8 0 0 - 5 2 3 - 2 0 0 0

Gain The Winning Edge With 486 Performance

Gateway's powerful 486 models give you the winning margin! And when you recap our recent price reductions and compare feature-for-feature against the other runners, you'll find you won't even have to play your hunches — Gateway 2000 is the odds-on favorite.

25MHz 486SX ■ $1995

At $1,995, our 486SX/25 is the hottest value on the market. With this system, you get 486 technology, including an 8K internal cache and burst mode, at a 386 price. And besides being faster than any 386 on the market, the 486SX/25 is upgradeable to 50MHz if you need increased performance in the future. ***System Highlights:*** 4MB RAM ■ 200MB Western Digital IDE hard drive ■ ATI™ Graphics Ultra ■ 14" CrystalScan 1024NI VGA color monitor, up to 1024 x 768 non-interlaced resolution ■ desktop model is standard

33MHz 486DX ■ $2495

We recently increased performance and lowered the price of our best-selling, award-winning 486DX/33 by adding an ATI Graphics Ultra video card with a graphics coprocessor. At $2,495, the price/performance ratio on this machine is hard to beat. Plus, it's an upgradeable PC. You'll be able to switch to 66MHz later this year. ***System Highlights:*** 64K cache RAM ■ 4MB RAM ■ 200MB Western Digital IDE hard drive ■ ATI Graphics Ultra ■ 14" CrystalScan 1024NI VGA color monitor, up to 1024 x 768 non-interlaced resolution ■ desktop model is standard

50MHz 486DX2 ■ $2795

Gateway 2000's new 486DX2/50 systems, ISA and EISA, incorporate Intel's speed doubler technology. The internal core of the DX2 processor executes at 50MHz while communicating with the external memory bus at 25MHz. Our benchmarks show a 35% increase in performance over a 33MHz 486DX PC.

The high-performance ATI card is standard on the 486DX2/50 as well, plus this system incorporates our new RIDE technology for faster disk operations. RIDE stands for Rapid Integrated Drive Electronics. RIDE technology takes advantage of our new system BIOS that allows the drive to transfer bigger data blocks at one time. Our Coretest benchmarks show large block disk-to-memory operations are over 30% faster with RIDE. For example, you'll notice the increased performance whenever you type WIN at the system prompt, or when you double-click on an icon in Windows. It's much faster. Our product marketing director claims the 486DX2/50 with the ATI video card and RIDE is the fastest personal computer he's ever used!

System Highlights: 64K cache RAM ■ 8MB RAM ■ 200MB Western Digital IDE hard drive with RIDE BIOS ■ ATI Graphics Ultra ■ 14" CrystalScan 1024NI VGA color monitor, up to 1024 x 768 non-interlaced resolution ■ desktop model is standard

EISA SYSTEMS

Our product line includes two EISA systems — a 33MHz 486DX and a 50MHz 486DX2. Both EISA systems now come standard in a floor-standing tower model, and include large, fast SCSI drives and EISA SCSI controllers. RAM cache is expandable to 256K. The 486DX/33 EISA will be upgradeable to 66MHz later this year.

System Highlights: 128K cache RAM ■ 8MB RAM ■ 340 MB Maxtor® SCSI hard drive ■ 32-bit EISA SCSI controller ■ 16-bit Diamond Speedstar Plus SVGA graphics with 1 MB ■ 14" CrystalScan 1024NI VGA color monitor, up to 1024 x 768 non-interlaced resolution ■ floor-standing tower model is standard

486DX/33 EISA ■ $3795 (Upgradeable to 66MHz later this year.)
486DX2/50 EISA ■ $3895

Gateway 2000 systems come fully configured with all the performance features you want, including two floppy drives, a programmable 124-key AnyKey keyboard, a Microsoft® mouse, MS DOS® 5.0, Windows,™ 3.1 and your choice of one application software option. See the back pages of this ad for complete configurations and information about software options, upgrades and peripherals.

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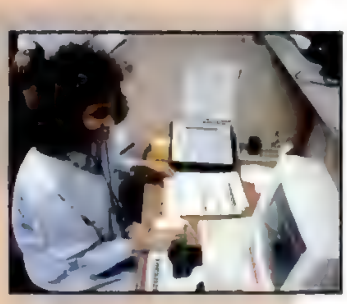
486 SYSTEMS

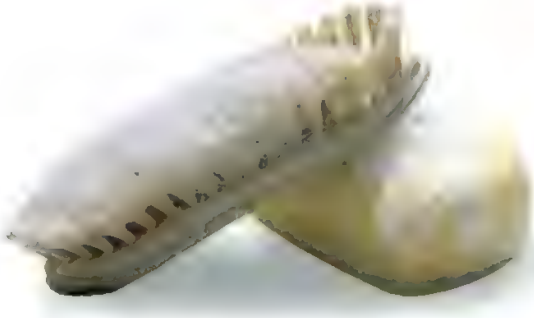


The Gateway Team Is Behind You All The Way

There's a full team of dedicated service professionals standing behind your Gateway 2000 system. In fact, a recent *PC Magazine* reader survey proved Gateway the clear winner in service and reliability. We whizzed past all the contenders when PC owners were asked, "How likely would you be to buy the same brand system again?" The survey also rated Gateway Number-One in overall system reliability, and we were in the Top Five for tech support and repair service.

Whenever you call our sales number, you get a friendly, human voice — a helpful representative to provide you with information. In our customer support department, we have over 200 people on-line to supply free technical support for the life of your machine. They're experienced, rigorously trained and tested and ever patient, friendly and helpful. You'll see why we say "you've got a friend in the business" at Gateway 2000.

In our company mission statement, one of our stated objectives is to exceed customer expectations in quality, service and value. This objective is a personal challenge to each of us at Gateway. We know how important service is to you, which is why we're constantly striving to provide the best in the business.



SERVICE

GATEWAY2000

"You've got a friend in the business."

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Gateway 2000 Adds A Bonus Payoff

Choose Your Software Option

With the purchase of any Gateway 2000 computer system, you receive your choice of one application software option at no additional cost. We'll install your software on your hard drive, optimally configured for your system and Windows, and provide master diskettes and manuals. You may also purchase a second application software option, pre-installed, at extremely competitive prices.

Installation and setup errors are responsible for over one-third of all software problems. You can eliminate that possible source of problems by purchasing your system from Gateway with software pre-installed, tested, and ready to run the moment your system arrives. Add that advantage to the hard-to-beat prices, and Gateway is the only logical choice for PCs and software!

Choose one of the following application software options:

Option #1-*Microsoft Excel for Windows™ 4.0*

■ New version of this powerful spreadsheet, includes online help for *Lotus 1-2-3®* users

Option #2-*Microsoft Word for Windows™ 2.0*

■ Best-selling word processor for Windows. New version 2.0 adds online help for *WordPerfect®* users

Option #3-*Microsoft PowerPoint for Windows™ 2.0*

■ Easy-to-use desktop presentations program creates high-quality overheads and 35mm slides

Option #4-*Borland® Paradox 3.5*

■ The award-winning database from Borland

Option #5-*The Entrepreneur Pack*

■ Includes the latest Windows versions of *Microsoft Works*™, integrating word processing, spreadsheet, and database in one easy-to-use program; *Microsoft Publisher*,™ for creating page layouts; *Microsoft Money*,™ to help you write checks, set budgets, track expenses; PLUS an *Entertainment Pack* with eight games, including *Tetris®*

Option #6-*The Windows Programmer Pack*

■ Includes everything you need to create programs for Windows: *Microsoft QuickC for Windows*™, *Windows Control Development Kit*™, *Windows Help Compiler*™ and *Windows Programmers' Online Reference*™.

Option #7-*Microsoft Project for Windows™ 3.0*

■ Flexible and easy project management program

NOTE: If you would rather replace an above option with *Microsoft Office*™, it is available for $175. This package includes *Word for Windows*, *Excel* and *PowerPoint*.

New! Second Applications At Great Prices!

The following applications are only available with the purchase of a system, pre-installed, or to Gateway customers.

Central Point® Anti-Virus 1.2 For Windows

Central Point Anti-Virus provides the most comprehensive virus protection for both corporate and single-user environments. Easy to use and transparent, its automatic operation provides total virus protection and advanced protection against unknown stealth viruses. ■ $75

Central Point Backup™ 7.2 for Windows

This is the first reliable, easy-to-operate backup program to offer full-featured DOS and Windows applications in one package ■ $75

The Norton Desktop™ 2.0 and Prisma Your Way 2.0 For Windows

Norton Desktop is a complete file management and utilities program for Windows. It visually integrates file and group management with an extensive collection of Peter Norton's best utilities. YourWay is a personal time and contact management system for Windows from Prisma, including card file, task manager, report, calendar and call management functions. ■ $95

These offers include the identical applications contained in retail packages but will not include the retail box. You get all master diskettes and manuals, shrink-wrapped and packaged in a Gateway 2000 box.

Central Point Commute

Whether you're running Windows or DOS, Commute lets you take remote control of your personal computer with complete security. Transfer files quickly between PCs using Commute's advanced continuous data compression system and reduce transmission time up to 50%. ■ $49

Peripherals

The Gateway 2000 Telepath™ Fax/Modem

The Gateway 2000 TelePath is a 14,400 bps modem, V .32bis, with 9,600 bps fax capability. The TelePath comes with WinFax Pro,™ Crosstalk™ for Windows, Qmodem™ and a free 30-day basic services CompuServe® membership — all for only $195!

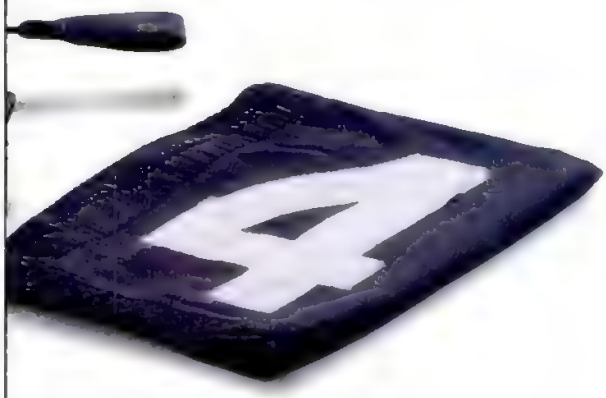
■ Fax mode: V.17, V.29 and V.27ter

■ Data mode: V.32bis, V.32, V.22bis, V.22, V.21, Bell 212A and 103, V.42 and MNP 2-4 error correction, V.42 bis/MNP 5 data compression

The 15-Inch CrystalScan 1572FS

The 15-inch CrystalScan color monitor has a flat, square, non-glare screen to reduce distortion around the corners and provide edge-to-edge display area. The CrystalScan 1572FS is an upgrade option only with the purchase of a 386DX or 486 system for an additional $195. (Availability is limited.)

Sorry — we sell peripherals only with the purchase of a Gateway 2000 system, or to people who are already Gateway 2000 customers. For fastest service, call our new direct line for the ***Component Add-On Division: 800-252-3333.*** *Please have your customer ID handy when you call.*



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GATEWAY 2000 WINNERS CIRCLE

PORTABLES

HANDBOOK™

- 286 Class Performance
- 1MB RAM
- 40MB Hard Drive
- Backlit 7.6" CGA Screen
- Size 5.9" x 9" x 1.4", 2.75 Lbs.
- 4-Hr.* NiMH Battery & Charger
- 1 Parallel/1 Serial Port
- 78-Key Keyboard
- DOS, File Transfer Software & Serial Download Cable
- Introductory Bonus Pack
- Carrying Case

$1295

NOMAD 325SXL

- 25MHz, 386SXL Processor
- 2MB RAM
- 1.44MB 3.5" Drive
- 80MB IDE Hard Drive
- Backlit 10" VGA Screen, 64 Grays
- Simultaneous Video with 256K
- Size 8.5" x 11" x 1.8", 5.8 Lbs.
- 7-Hr.* NiCad Battery & Charger
- 1 Parallel/1 Serial Port
- 79-Key Keyboard
- FieldMouse™ Pointing Device
- MS DOS® 5.0 & Windows™ 3.1

$1995

NOMAD 420SXL

- 20MHz, Intel® 486SXLP Processor
- 4MB RAM
- 1.44MB 3.5" Drive
- 80MB Hard Drive
- Backlit 10" VGA Screen, 64 Grays
- Simultaneous Video with 1MB
- Size 8.5" x 11" x 1.8", 5.8 Lbs.
- 6-Hr.* NiCad Battery & Charger
- 1 Parallel/1 Serial Port
- 79-Key Keyboard
- FieldMouse Pointing Device
- MS DOS 5.0 and Windows 3.1

$2795

NOMAD 425DXL

- 25MHz, Intel 486DXLP Processor
- 4MB RAM
- 1.44MB 3.5" Drive
- 120MB Hard Drive
- Backlit 10" VGA Screen, 64 Grays
- Simultaneous Video with 1MB
- Size 8.5" x 11" x 1.8", 5.8 Lbs.
- 6-Hr.* NiCad Battery & Charger
- 1 Parallel/1 Serial Port
- 79-Key Keyboard
- FieldMouse Pointing Device
- MS DOS 5.0 and Windows 3.1

$3495

DESKTOPS

25MHz 386SX

- Intel 386SX Processor
- 4MB RAM
- 1.2MB & 1.44MB Drives
- 80MB 17ms IDE Cache Drive
- 16-Bit SVGA with 512K
- 14" CrystalScan 1024 Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey™ Keyboard
- Microsoft® Mouse
- MS DOS 5.0 and Windows 3.1
- Choice of Application Software

$1595

25MHz 486SX

- Intel 486SX Processor
- 4MB RAM
- 1.2MB & 1.44MB Drives
- 120MB 15ms IDE Cache Drive
- ATI™ Graphics Ultra Video
- 14" CrystalScan 1024NI Color VGA Monitor
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- Other systems in our product line: 16MHz 386SX, 20MHz 386SX, 25MHz 386DX, 33MHz 386DX, 33MHz 486DX EISA. Call for details and pricing.

** Battery life was measured using PC Magazine's Battery Rundown Test with power management enabled. Actual results may vary depending on configuration and applications.*

All prices and configurations are subject to change without notice. Prices do not include shipping. Components, peripherals and software are sold only with the purchase of a system, or to customers who already own Gateway 2000 systems. Some limitations apply.

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■ Spreadsheets

SmartIcons and Backsolver Are Time-Savers, but 1-2-3 Upgrade Isn't Essential

BY CRAIG STINSON

The two new features and one fix in Lotus 1-2-3, Release 2.4, aren't totally inconsequential, but they have more to do with maintaining feature parity with Quattro Pro and Excel than with enhancing the state of the art in spreadsheets.

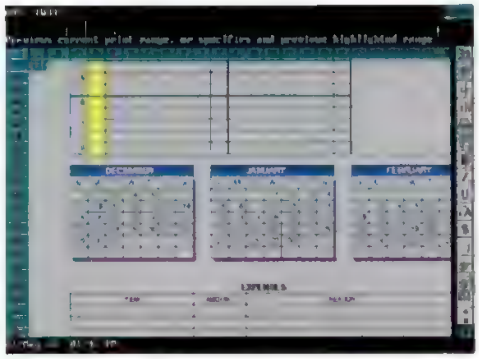
For the standard upgrade fee of $150, Release 2.4 gives you a customizable SmartIcon palette similar to the one that Lotus introduced last year with 1-2-3 for Windows, and a backsolver (goal-seeker). The fix is that worksheets can now be printed in landscape mode on dot matrix and ink jet printers.

In keeping with its well-established strategy of leaving a very good thing (the Release 2.*x* kernel) alone, Lotus has implemented both new features as optional add-ins. The backsolver and SmartIcons can be attached and detached, or configured to attach themselves at the start of every session. That's good, because both services need memory: The backsolver takes about 45K and the icons about 24K.

The icon palette occupies a vertical strip along the right side of the screen. Lotus provides some 70 icons covering most of the basic formatting, editing, and navigation commands, as well as handy buttons for summing and sorting.

The icons are handiest for mouse users, but they're available to keyboard users as well. Typing the add-in's access key (Alt-F7, for example) puts you at the top of the icon panel. From there, you can use the cursor keys to select an icon and press Enter to execute it.

The new SmartIcons serve two principal purposes: They let you customize the program so that the commands you use most often are easy to get to, and they provide a simple way to execute everyday productivity macros. Twelve icons can be assigned macro code—either simple, noninteractive instructions or {branch} commands that invoke code stored elsewhere—on the worksheet or in a macro library maintained by Lotus's Macro Manager add-in.



SMART SCREEN: *Choose from 70 icons to set up 1-2-3's new SmartIcon palette.*

The additions to 2.4 do make sense. The backsolver is a time-saver, allowing you to reverse the normal "what if" problem-solving sequence. The icon palette makes 1-2-3 more convenient to use. And the landscape capability eliminates a major irritant for those without laser printers. Nevertheless, this is not an essential upgrade.

• *List Price: Lotus 1-2-3 for DOS, Release 2.4, $495; network server edition, $795; standard and competitive upgrade, $150; upgrade for buyers of 1-2-3 between November 1, 1991 and May 31, 1992, $49. Requires: 384K RAM (512K for WYSIWYG), DOS 2.1 or later. Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; 617-577-8500.*

Circle 429 on reader service card

■ Spreadsheets

Baler Converts Your Spreadsheets into Standalone Applications

BY CRAIG STINSON

If you create many spreadsheets or supervise their distribution and consolidation, a spreadsheet compiler can help you get your job done more effectively. With either the $495 Baler, Version 6.0, or its $795 BalerXE, Version 2.0, sibling, a spreadsheet developer can now completely transform the appearance, power, and security of applications written in Lotus 1-2-3's macro code.

As compilers for .WK1 files, both products let you convert worksheets and macros from most DOS spreadsheets into standalone .EXE files. Compiling lets you make your spreadsheets safe and gives you the chance to customize the application you're creating. By "baling" a spreadsheet application, you can protect both worksheet logic and macro code from inspection and tampering. And by running the included Customiz program you can modify the appearance and content of the spreadsheet.

While the underlying code that drives the application may be 1-2-3, the appearance and style of the finished program may not resemble a spreadsheet at all.

BalerXE, a superset of Baler, gives you a C API and library, allowing you to augment the power of the spreadsheet engine with custom functions and macro keywords.

Like a QuickC or Turbo Pascal programmer, the Baler developer can now carry out all steps from a single "workbench," and the new versions add 72 verbs to the standard 1-2-3 macro language. The macro verbs allow customizing features to be turned on and off during the course of a program.

Baler and BalerXE add welcome improvements to what was already a full toolkit for developers of spreadsheet applications.

• *List Price: Baler, Version 6.0, $495; BalerXE, Version 2.0, $795. Requires: Baler: 640K RAM, 2MB hard disk space, DOS 3.3 or later. BalerXE: 640K RAM, 4MB hard disk space, DOS 3.3 or later. Baler Software Corp., 1400 Hicks Rd., Rolling Meadows, IL 60008; 800-327-6108, 708-506-9700; fax 708-506-1808.*

Circle 430 on reader service card

■ Software

Windows Personal Librarian Turns Data into Information

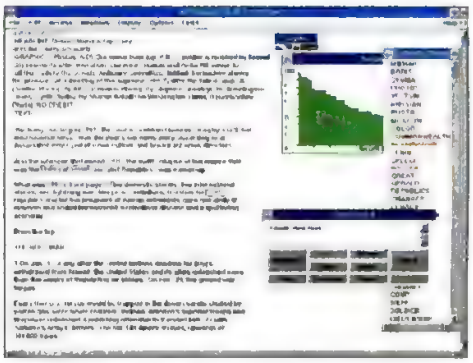
BY JAMES KARNEY

How do you find the information you need efficiently when the data you have access to on hard disks and networks climbs up into the gigabyte range? Windows Personal Librarian (WPL) is like having a trained research librarian on call to manage the task. This $995 Windows-based program from Personal Library Software can give you capabilities normally found on dedicated full-text image retrieval systems, without programming or file conversions.

WPL's search engine was originally designed for large-scale and CD-ROM information management applications. The database can include text, graphics, hypertext, and linked sound and animation. It can be small, with a few word processing files, or huge—up to 4GB with 16 million records. Multiple databases can be searched at the same time, which makes the size of your storage system the limiting factor.

The real power of this program lies in its sophisticated searches. You enter a query using words or complete sentences like "Look up the files on the Iran-Iraq War." You can also use phrases, logical operators, and wildcards in your query. If you are unsure of spelling, the Fuzzy option will look for similar words.

We queried with the string "Iran-Iraq War" on a 3MB database containing 1,045 articles from newspapers of the late 1980s. The WPL main window displayed the document that the program considered the most important out of the 135 located. Scrolling through the rest of the selections was just a matter of using the plus and minus keys.



FAST SEARCHES: *Windows Personal Librarian has powerful full-text database features and sophisticated searches.*

AUTOMATIC WORD LISTS

The Expand and Concept options automatically generate lists of words for further investigation. The list we got for the Iran-Iraq query included North, Poindexter, Contra, and Sandinista, as well as Saddam, the names of Iranian leaders, and the reporters who wrote the articles. Any of these could be added to the query by clicking on them with the mouse. Other available windows list all matching files, show a bar chart indicating how focused the query is, and display a dictionary containing all the words in the database (except stop words like an, and, the, and so forth).

The search engine uses a number of statistical models to locate relevant information. The recovery quality gets better as the amount of data being examined increases. Instead of just placing files in the list as they are found, WPL ranks the documents with the most interesting ones first. The quality of these recovery techniques is excellent.

The time it takes to complete a search depends on the total size of your files. We used the archives of London's *The Independent* (which are already indexed for Personal Librarian on a CD-ROM containing 455MB of data) during informal testing on a 33-MHz 486 system with Microsoft Word for Windows running at the same time. Complex six- and seven-word Boolean queries took 4 to 6 seconds. With a 2MB database containing hypertext and graphic links located on a hard disk, the same type of query took less than 2 seconds. Simple three- and four-word search strings executed in 3 seconds and less than 1 second, respectively, for the two databases.

SETTING UP TO SEARCH

There are two levels of sophistication when setting up WPL. The basic level lets novice users set up and query databases using the program's defaults. Advanced features require more work, but using them is less complicated than designing spreadsheets.

Creating a new database is handled via the PL-Admin utility. Just select any combination of ASCII, Microsoft Word, or WordPerfect files you want to include. The files require no special modification and can reside on any storage device available to your computer, either locally or on a network.

Once the files are selected, an index file is automatically generated, which can take a while if you have a lot of files. Indexing can run in the background, and the final file will be 50 to 60 percent of the size of the source files. More files can be added to the database without building a new index.

Personal Library software is also available in DOS, Macintosh, Unix, and VMS versions. All can use shared databases. There is also an OCR Connection utility sold separately that can automatically add documents scanned using Calera or Kurzwiel optical recognition software to a target database.

Windows Personal Librarian lets you find and organize information you may not have realized you needed to see when you asked your question. Its ease of use and powerful search features justify its relatively high price tag. □

FACT FILE

Windows Personal Librarian, Version 3.0

Personal Library Software, 2400 Research Blvd., #350, Rockville, MD 20850; 301-990-1155

List Price: $995
Requires: 2MB RAM (4MB recommended), 4MB hard disk space, Microsoft Windows 3.0 or later.
In Short: A very powerful retrieval tool that turns large amounts of electronic data into easily searched information. Its easy-to-use interface lets you perform sophisticated searches immediately.

422 ON READER SERVICE CARD

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CIRCLE 285 ON READER SERVICE CARD

■ Accounting

QuickBooks: Small-Business Accounting Never Looked So Simple

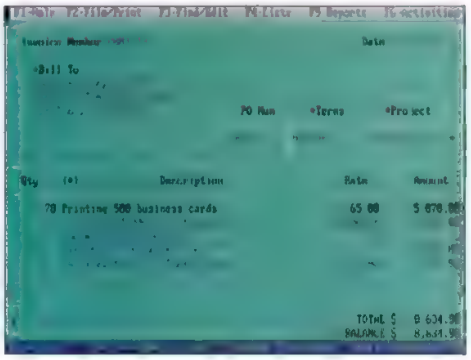
BY GREGG KEIZER

The two best things you can say about QuickBooks, Intuit's new small-business accounting program, is that it's a lot like Quicken and that it's a lot like Quicken. The echo is important to the hundreds of thousands of Quicken owners who struggle to make that electronic checkbook package perform like a full-blown accounting system. QuickBooks not only feels familiar to Quicken users, it also shares that popular program's philosophy of easy entry, plain English commands, and solid financial reporting.

But QuickBooks, which shipped too late to be included in our recent accounting roundup ("Low-Cost Accounting Software: Big Gains for Small Business," May 12, 1992), is no upgrade. This $139.95 package may have Quicken's look and feel, but it adds and integrates the basic accounting modules most needed by small businesses: invoicing, accounts receivable, and accounts payable. Though it's missing a comprehensive payroll and plays dumb on inventory, QuickBooks nevertheless is an impressive electronic bookkeeper.

Small businesses use Quicken because it's easy to use, and QuickBooks retains that ease of use. Twenty-one predefined charts of accounts, representing everything from religious organizations to medical practices, help you set up your books. QuickTrainer, a semi-intelligent tutor that can run independently of the program, offers accounting instruction. The program's documentation, though complete, is almost unnecessary since QuickBook's context-sensitive help not only answers questions, it walks you through most procedures. And Quicken's no-nonsense approach to finance is duplicated in QuickBooks, which even swears off the often confusing General Ledger and hides double-entry bookkeeping from you.

Quicken data is fully compatible with QuickBooks, so you get a leg up if you're moving from checkbook to bookkeeping. Don't expect the accounts receivable and payable you jury-rigged in Quicken to transform into QuickBooks versions, though: You'll have to record payments and note receipt of checks in those old accounts until they're exhausted.



PAPER-LIKE: *You write an invoice in QuickBooks just as you do a check—on a form-style screen that mimics paper.*

INVOICING AND RECEIVABLES

QuickBooks' most notable addition to small-business bookkeeping is its accounts receivable and associated invoicing. Though many small firms can do without accounts payable, every company needs a way to generate bills and track the money it is owed.

QuickBooks excels here, since it offers three different types of invoices for products, services, and professions; generates statements; and prints labels. You can customize any invoice so that it calculates sales tax and markup, though you're restricted to five printing styles. Unfortunately, unlike a Windows package such as the Editors' Choice M.Y.O.B., QuickBooks makes no allowances for forms design or even modification.

Paying bills—either via the checkbook or through accounts payable—is done on the familiar register-style screen. Though some businesses may prefer to stick with the checkbook, QuickBooks' accounts payable gives a more accurate picture of company finances. It automatically generates sales tax collection checks and eliminates the need to post-date checks. You can move up from a checkbook to an accounts payable system at any time.

QuickBooks has 15 ready-to-use reports, which, like Quicken's, can be modified through a system of filters and then memorized for later recycling. Small business–specific reports, such as the 1099 form for accounts payable and the aging report for receivables, aid in chores like providing information to an outside accountant and dunning clients for money.

Payroll may be less than comprehensive in QuickBooks—for instance, you need Intuit's complimentary QuickPay to calculate withholding—but it does automate payroll check-writing. A more significant detriment is the lack of an inventory module; the most you can do is set up a quick-call product and price list that's useful when you generate invoices. If you're selling *things*, not services or time, and you need to track that inventory, stay away from QuickBooks.

If you've been using Quicken to keep your small-business books, go directly to QuickBooks. You'll find the old data compatible, the interface familiar, and the program packed with the accounting modules your small business needs most desperately. And if your company still accounts on paper, not silicon, take a good look at QuickBooks. It's the slickest solution yet for anyone who breaks into a nervous sweat at the sound of the word "debit." □

FACT FILE

QuickBooks, Version 1.0

Intuit, P.O. Box 3014, Menlo Park, CA 94026; 800-624-8742; fax 415-322-1013

List Price: $139.95 ($54.95 for current Quicken users, or $30 rebate available if purchased at retail).
Requires: 640K RAM, 1.9MB hard disk space, DOS 2.1 or later
In Short: QuickBooks strips away confusing accounting terminology as it hands invoicing, accounts receivable, accounts payable, and some payroll functions to small and home-based businesses. It's extraordinarily easy to use, yet provides plenty of accounting power.

425 ON READER SERVICE CARD

Introducing Quattro Pro 4.0 The only DOS spreadsheet with pushbutton power!

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Quattro Pro beats 1-2-3 . . . again!

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Most Powerful	**Yes**		
Intelligent Graphs	Yes	No	No
Novell Network optimized	Yes	No	No
Multiple sheets	Yes	No	Yes
Multi-variable solver	Yes	No	*
Easiest to Use	**Yes**		
SpeedBar	Yes	No	No
Print-To-Fit	Yes	*	*
Read Lotus 1-2-3 files, styles & macros	Yes	Yes	Yes
Best Performance	**Yes**		
All features in 640K	Yes	?	No
Price	**$495**	**$495**	**$595**

? Yes, but almost no room remains for data
*Yes, but requires attaching an add-in

Quattro Pro's customizable, built-in SpeedBar™ is a row of clearly labeled buttons that use simple English commands to give you instant mouse-click access to your frequently used features and macros. Plus you get immediate access to a host of new features.

New SpeedBar

Intelligent Graphs let you perform extended analysis with your graphs without changing your data. And Quattro Pro's Optimizer™ allows you to solve complex problems using multiple variables.

New Intelligent Graphs

The best spreadsheet on networks

Only Quattro Pro 4.0 gives you superior Novell NetWare support, including automatic logon, drive mapping and a new Print Queue Manager.

New Novell Support

The most feature-packed DOS spreadsheet ever!

And in addition to Quattro Pro 4.0's dramatic new advances, you get the features that have made it the #1-rated spreadsheet in the world. Features such as WYSIWYG, Print-To-Fit™ spreadsheet output, superb 1-2-3® compatibility (you can even read Allways, Impress and WYSIWYG files) and more.

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Quattro Pro has won more awards for technical excellence and customer satisfaction than any other DOS spreadsheet. In fact, in the prestigious J.D. Power and Associates® survey, Borland was ranked #1 (tied) for Application Software Publisher in Customer Satisfaction Among Business Users.[1]

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BORLAND
Software Craftmanship

[1] J.D. Power and Associates 1991 Computer End User Satisfaction Study: Phase IV: Business End User Summary. Responses from 4,396 business sites. Copyright © 1992 Borland International, Inc. All rights reserved. All Borland products are trademarks of Borland International, Inc. Pricing is in U.S. dollars. Offer good in U.S. and Canada only. Dealer prices may vary. BI 1471B

CIRCLE 287 ON READER SERVICE CARD

Video

Matrox Impression: True Color and Speed At the Right Price

BY JAMES KARNEY

Slow and cheap or fast and expensive. That's been your only choice when buying true-color, 24-bit display cards. The Matrox Impression 1024 is an alternative: For $1,295, it offers 16.7 million colors at three times the speed of nonaccelerated 256-color, 8-bit Super VGA cards. Compared with souped-up high-resolution coprocessed adapters like the VideoLogic Rapier 24, the Impression 1024 offers half the speed at less than half the cost.

Based on a VGA-compatible S3 86C911 accelerator, 3MB of VRAM, and a Brooktree 484 RAMDAC, the Impression features pan and zoom capability, a series of 24- and 8-bit drivers for Microsoft Windows, and resolutions from 640-by-480 to 1,024-by-768 in both modes.

We informally tested the Matrox and a Video7 VRAM II with 1MB of VRAM on a 33-MHz 486 system. The Impression 1024 was nine to ten times faster with 256 colors and three times faster with the true-color driver.

We ran Microsoft Word, CorelDRAW, and Aldus PhotoStyler at the same time in 24-bit mode. Screen redraws are quite acceptable, except with very complex gradient fills or very large bitmapped images. In 8-bit 1,024-by-768 mode, the card works like other S3-based accelerators—very fast.

Bundled utilities include Consistent Color calibration for adjusting the color and tone sent to the monitor. If you plan on doing true-color image editing, matching the output of your scanner, monitor, and printer is very important. To save room on your hard disk, the WinSqueeze JPEG compression program shrinks true-color images from 10:1 to 15:1.

If you're looking for a relatively budget-priced true-color card that offers high resolution and good performance, take a look at the Impression 1024.

• *List Price: Matrox Impression 1024 True Color Controller, $1,295. Matrox Electronic Systems Ltd., 1055 St. Regis Blvd., Dorval, Quebec, Canada H9P 2T4; 800-361-4903, 514-685-2630; fax 514-685-2853.*

Circle 424 on reader service card

Video

VideoLogic Rapier 24 Meets Demands Of High-End Graphics Work

BY BEN MYERS

If you do graphic arts work and rely on displaying deep-color photographs and images, then your graphics applications deserve the perks of advanced video technology.

The VideoLogic Rapier 24 graphics board is a costly blend of true 24-bit color and high resolution for use with Windows and high-end graphics software. Reaching up to 1,152-by-882 resolution, the $2,995 Rapier 24 packs a 32-MHz Texas Instruments 34020 graphics processor, 1MB of program memory, and 3.5MB of video memory.

It pushes the maximum size limit for an ISA-bus board, so be sure you have enough headroom. The board requires careful installation, but once it's up and running, it performs splendidly.

The Rapier 24 has no on-board VGA capabilities, which are needed by a PC during power up and for DOS command line operation. VideoLogic provides two VGA pass-through cables that enable the Rapier 24 to connect in a single-monitor setup with most VGA, Super VGA, and Windows accelerator graphics cards.

The performance of the Rapier 24 under 24-bit Windows is twice that of the $1,295 Matrox Impression 1024, and it stacks up quite favorably against the performance of other graphics adapters operating with only 256 colors.

Its maximum 1,152-by-882 resolution fits nicely into the on-board video memory and yields the ideal 4-by-3 aspect ratio afforded by the more common resolutions. It also handles a full range of resolutions: 640-by-480, 800-by-600, and 1,024-by-768.

The Rapier 24 has a TIGA 24-bit driver for Windows 3.0 and 3.1 and a display list driver for Autodesk's AutoCAD, AutoShade, and 3D Studio. A Zoom utility magnifies up to eightfold to make editing of single pixels a less painstaking job.

For $2,995, you might expect easier installation and more polished documentation, but the Rapier 24 offers a rare combination of speed and 24-bit color resolutions.

• *List Price: VideoLogic Rapier 24, $2,995. VideoLogic Inc., 245 First St., Cambridge, MA 02142; 617-494-0530.*

Circle 431 on reader service card

Windows Benchmark Tests

PC Labs tested both the $1,295 Matrox Impression 1024 and the $2,995 VideoLogic Rapier 24. Both boards offer 24-bit true color, but the coprocessed Rapier justifies its higher price with far faster performance. For comparison, we've included the result for the less powerful 8-bit, $445 Diamond Stealth VRAM board; it's fast, but it does not offer 24-bit color.

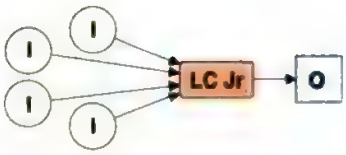
The **WINMARK** results represent the geometric mean of 11 WINBENCH graphics tests. WINMARK takes into account tests of 11 key video functions and weights them to reflect how frequently the functions are used. Higher scores represent better performance

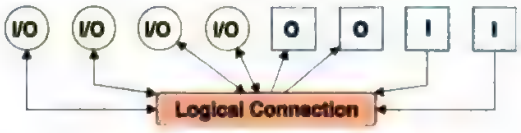
WINMARK, Version 2.5
1,024-by-768 resolution with 256 colors

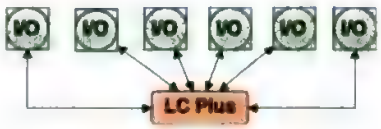
Diamond Stealth VRAM (8-bit)	6,096,769
VideoLogic Rapier 24 (24-bit)	3,696,823
Matrox Impression 1024 (24-bit)	1,796,184

Printer Sharing

= PARALLEL DEVICE = SERIAL DEVICE = PARALLEL OR SERIAL DEVICE I = INPUT FROM PC O = OUTPUT TO PERIPHERAL

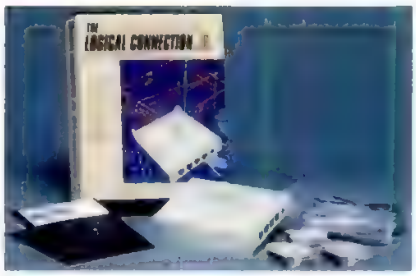






LC Jr.-256Kb $239

Serially connect up to four PCs to the **Logical Connection Jr.** at speeds up to 115,200 bps. It will automatically convert the data for easy sharing of one parallel printer.



LC-512Kb $495

The **Logical Connection** has eight ports: four bi-directional serial ports which can be set as input or output, two parallel inputs and two parallel outputs.

LC Plus-512Kb $695

All six ports of the **Logical Connection Plus** are automatically configured as parallel or serial, and input or output. Versatility and high speed are key features.

- **UL Listed Power Supplies**
- **FCC Class B Certification (LCJr. - A)**
- **Fast Data Input and Throughput**
- **Socketed DRAM Upgrades to 1Mb**
- **Largest Selling PSDs in the USA**

Logical Connections allow several users to easily share expensive printers and other resources. Choose the peripheral that you need with a pop-up menu or ASCII string.

Multiple users can send data simultaneously since Logical Connections with memory will buffer and queue jobs on a first-in-first-out basis. A 256Kb buffer will hold up to 100 pages of text or about 5 - 10 pages of graphics data.

If your company has a LAN, use Logical Connections for local printer sharing in smaller workgroups, rather than printing centrally through the LAN. Local printing is more convenient and more secure!

LC -41PAS $100

Smart switch to automatically connect up to 4 parallel inputs to 1 parallel output.

SPPS $60

Serial/Parallel or Parallel/Serial converter, no power supply required.

Logical Connection, Inc.
4660 Portland Road NE #108, Salem, OR 97305
FAX: (503) 390-9372
Tech. Support: (503) 390-9375

LOGICAL CONNECTION 800-238-9415 US & Can.

Laptop Memory

Macintosh Powerbook 100 (Dealer must install)

Memory Module	EPB-2000	2 Mb	$275
Memory Module	EPB-4000	4 Mb	$500

Macintosh Powerbook 140/170 (Dealer must install)

Memory Module	EPC-4000	4 Mb	$500
Memory Module	EPC-6000	6 Mb	$750

Toshiba Laptop Models: (User may install)

1000SE/XE/LE, 2000, 2000SX (All Sizes); 2000SXE, 2200SX (exclude 1Mb)

Memory Card	RCT-1000	1 Mb	$150
Memory Card	RCT-2000	2 Mb	$200
Memory Card	RCT-4000	4 Mb	$400
Memory Card	RCT-8000	8 Mb	$700

PC-MCIA 2.0 / JEIDA SRAM (User may install)

For Laptops conforming to this new universal spec.

Memory Card	RJB-0512	512 Kb	$195
Memory Card	RJB-1000	1 Mb	$450
Memory Card	RJB-2000	2 Mb	$750

CIRCLE 131 ON READER SERVICE CARD

Memory Management

920K Free RAM? Memory Commander Can Deliver It Easily

BY BARRY SIMON

In the crowded memory management market, V Communications is carving out a niche for itself with Memory Commander, a $99.95 wizard able to deliver huge DOS memory blocks. Unlike other memory managers, Memory Commander keeps information on loading programs in an internal database rather than in obscure command lines sprinkled throughout your CONFIG.SYS and AUTOEXEC.BAT files.

Also unique are its RAM disk and ANSI driver, which require no memory below 640K. New to Version 3.0 are EMS/XMS pooling, Windows 3.1 support, and an automated method for reoptimizing whenever a new device or TSR is detected.

Memory Commander runs in one of five modes. Modes A and B match what other memory managers do, but the program's three extra modes increase the memory DOS can access by moving screen memory, video ROM, and disk ROM. Mode C lets you use high-resolution graphics, while modes D and E are for text mode only. Modes D and E can free up to 920K of RAM on VGA systems.

For many programs, Memory Commander must intercept and redirect video calls and screen writes when in modes C, D, or E. This introduces overhead of up to 50 percent in mode C, and even more for a few cases like WordPerfect's graphics preview. Fortunately, you can tell Memory Commander to run such programs in a more compatible mode.

Windows runs only in mode A, so the DOS extending magic isn't available there. But with Windows 3.1, UMB support with instancing is available.

WHAT INTERFACE? *Memory Commander is easy to use, given the complexity of what it does.*

Version 3.0 fixes the biggest problem of earlier versions: XMS and EMS memory now reside in a common pool. Memory Commander, however, doesn't do anything to squeeze out extra bits of UMB space like QEMM-386's Stealth or NetRoom's Quantum and Netswap do. Nonetheless, Memory Commander remains your best memory management choice if you have a special need for huge amounts of DOS memory.

• *List Price: Memory Commander, Version 3.0, $99.95. Requires: 512K RAM, DOS 3.0 or later. V Communications, 4320 Stevens Creek Blvd., #275, San Jose, CA 95129; 800-648-8266, 408-296-4224.*

Circle 434 on reader service card

Utilities

List: Shareware File Viewer Goes Commercial

BY TONY POMPILI

Managing and viewing a wide range of text files is the special talent of List Enhanced, the first commercial release of one of the most popular shareware programs ever. Version 1.84 now includes support for EBCDIC IBM mainframe–type files, built-in file compression, and new enhanced video modes.

For $99, the new List adds features that enhance the product's reputation as a master text-file viewer and disk management tool. The program can take nearly any type of text file—in ASCII or word processor format—and quickly pop it up on the screen with a simple DOS-like command. List offers a range of text formatting and navigation commands such as text searching and word wrap, and includes a split screen that can display two files simultaneously.

Besides EBCDIC, List Enhanced has filters for reading eight- and seven-bit file formats as well as hexadecimal files. A Junk filter cleans up files with carriage returns at the end of every line. The program can view files of up to 32MB, making it suitable for viewing even the biggest database files.

To complement List's ability to view large files, the program now offers a variety of video modes, including 132-by-25, 132-by-43, and 80-by-43 characters. The modes you get, of course, are dependent on your graphics adapter and monitor.

On the disk management side, the Viewer now offers file tagging. Sets of tagged files can be acted upon by the new Sweep command, which runs a single DOS command on the whole tagged group. Also new to List Enhanced is a tree directory display.

For those trying to save disk space, List now has built-in features for managing ARC, LHARCC, PKZIP, and other compressed files. Besides the ability to compress and extract files right from List's Viewer, you can view compressed files without first extracting them.

Although you can't actually edit in List Enhanced, the program does let you shell out to your favorite editor.

For quick file viewing and management, the low-profile List Enhanced is better than ever.

• *List Price: List Enhanced, Version 1.84, $99; upgrade, $49. Requires: 128K RAM, DOS 2.01 or later; Buerg Software, 139 White Oak Circle, Petaluma, CA 94952; 707-778-1811.*

Circle 428 on reader service card

Can You Spot The One Computer We Don't Protect from Viruses?

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PC MAGAZINE EDITORS' CHOICE

Oct. 29, 1991
CPAV 1.1

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Central Point Software Inc.

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CIRCLE 079 ON READER SERVICE CARD

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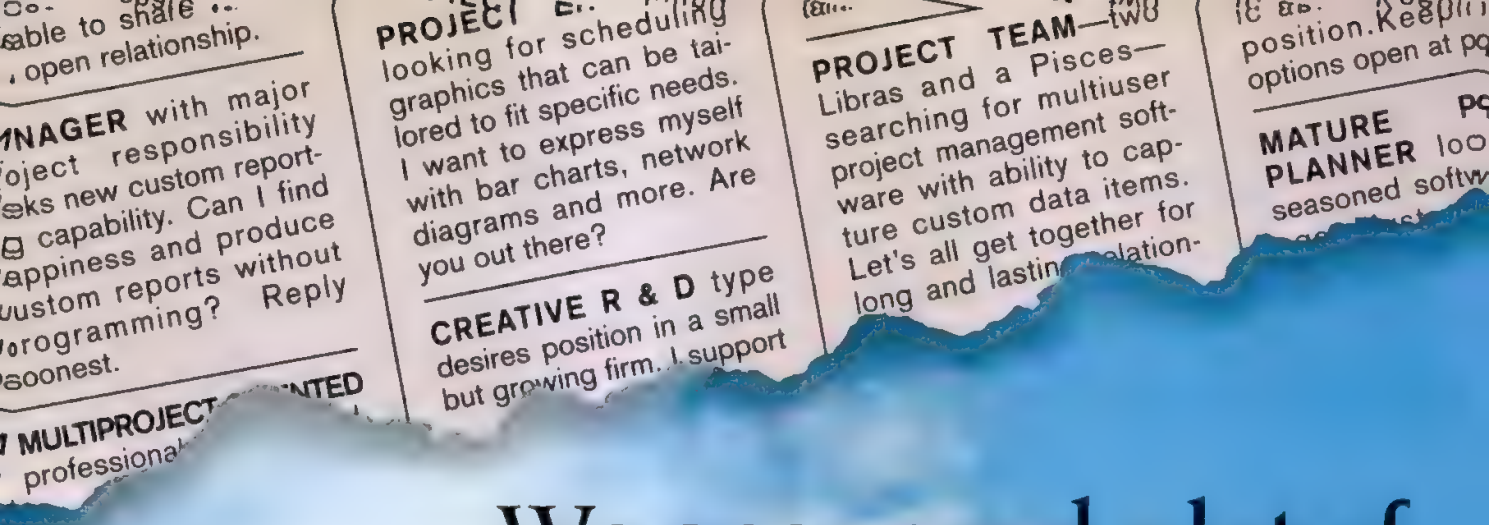

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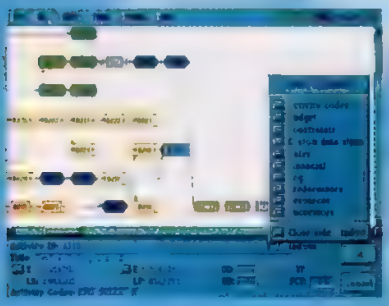
This could be the start of a beautiful relationship. You and the 5.0 version of Primavera Project Planner.® It offers the power of the world's leading high performance project management software…combined with an exceptional array of customizing, "do it your way" features, reports and graphics.



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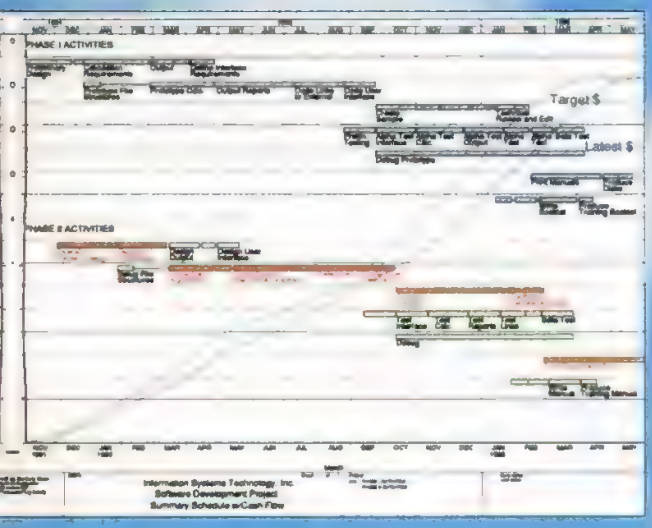

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CIRCLE 148 ON READER SERVICE CARD

New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

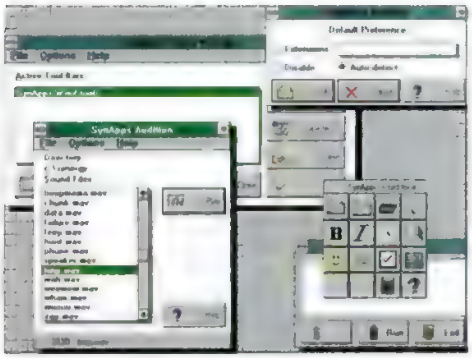
By Emerson Andrew Torgan

NEW

Synergy Offers a New Approach To Windows Utilities

SynApps Software's collection of Windows utilities seems a bit outlandish at first glance, with programs named "Psychic" and "Audition," to name a few. A closer look at Synergy, Version 1.0, reveals nine useful items for use with all Windows applications.

Eclipse provides a customizable floating button bar that lets users assign commands and operations to each button. The bar remains visible even when you are switching between applications and ships with predefined commands for popular Windows applications such as Word for Windows and Excel. Psychic is a utility that attempts to stay one step ahead of you by monitoring recent file access. At a click of the mouse, Psychic



Synergy offers many useful Windows utilities.

"predicts" which file you want next and provides a list of alternative choices.

Seven additional utilities—FileFetch (for finding, accessing, and deleting files), LaunchPad, SynApps Script Language, the Picasso icon editor, the FX special-effects creator (including shaded and "zooming" windows), the Audition .WAV-compatible sound utility, and the SynAppShot screen-capture utility—round out this unique collection. All feature drag-and-drop functionality between utilities and independently.

• *List Price: Synergy, Version 1.0, $129.95. SynApps Software Inc., 2009 178th Ave. NE, Redmond, WA 98052; 206-562-3015.*

Circle 402 on reader service card

HOT PROSPECT

CorelDRAW 3.0 Gains Graphics Modules, Lower Price Tag

Feeling the heat from Micrografx's Designer and Gold Disk's upcoming Professional Draw, **Corel Systems Corp.** shifted into high gear with its release of CorelDRAW 3.0. The new version of the popular graphics illustration package, with a new price of $595 ($100 less than previous versions), combines vector illustration, business charting, image editing and painting, and presentation in an effort to provide a complete graphics software solution.

CorelDRAW 3.0 consists of six modules: CorelDraw, CorelPhoto-Paint, CorelChart, CorelShow, CorelMosaic, and CorelTrace. The new charting and graphing module lets you make bar, bullet, and title charts. 3-D charts, graphs, and bitmapped images can be assembled into presentations using the new slide sorter and templates.

Users can now type and edit text directly on-screen and work in a new editable color preview mode, as well as in wireframe mode. Additional enhancements include more undo levels, on-line help, object locking, layering, and support for OLE (object linking and embedding).

• *List Price: CorelDRAW, Version 3.0, $595. Corel Systems Corp., 1600 Carling Ave., Ottawa, Ontario, Canada K1Z 8R7; 800-836-3729, 716-423-8200.*

Circle 401 on reader service card

NEW

Dell PC Provides High-Speed Video Ride on the Local Bus

Dell's PowerLine 450DE/2 DGX (Direct-coupled Graphics Xccelerator) PC delivers accelerated graphics performance by letting the CPU manage pixels in video memory. The system offers graphics performance that is seven to ten times as fast as Super VGA solutions, according to the company.

Based on Intel's 486DX2 "speed-doubling" processor, the unit features 128K of secondary cache memory and 2MB of video memory directly attached to the processor bus. The Dell PowerLine includes a 32-bit EISA bus and ships in a standard configuration with 4MB RAM, an 80MB hard disk, dual floppy disk drives, and a 16-inch Dell Graphics Performance Display monitor.

• *List Price: Dell PowerLine 450DE/2 DGX, $5,499. Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759; 800-289-3355, 512-338-4400.*

Circle 403 on reader service card

NEW

Mustek Unveils Color and Gray-Scale Sheet-Fed Scanner

Mustek (formally Martek Inc.) is now shipping the MS-2300C, a 300-dot-per-inch sheet-fed scanner for the Windows environment that provides both 24-bit color and 256 gray scales. Documents and images are fed into the top of the unit for a single-pass scan with continuous brightness control. A trichromatic filter sharpens color images.

The desktop unit is bundled with Perceive Automatic Optical Character Recognition software and Picture Publisher, Version 3.0, providing image-editing functions and support for various graphics file formats. The maximum scanning size is 8.5 by 14 inches.

• *List Price: Mustek MS-2300C, $999. Mustek Inc., 15225 Alton Pkwy., Irvine, CA 92718; 714-833-7740.*

Circle 404 on reader service card

NEW

Double Your Remote LAN Communications Power

Cubix Corp. has unveiled the QL 3002, a dual 386SX asynchronous communications processor board that effectively doubles the remote communications potential of a single slot in a file server running NetWare. The two separate processors, running at 25 MHz each, can serve two independent users simultaneously.

The QL 3002 offers remote users up to 16MB RAM, VGA support, I/O handling, and bus-based network throughput (moving data in parallel across the bus instead of serially on a network cable), and it provides additional memory for graphics-intensive applications. Each processor has a math coprocessor socket, a SIMM socket, and a 16C552 dual serial I/O chip to optimize communications. A 16K I/O buffer controls distant high-speed modem connections.

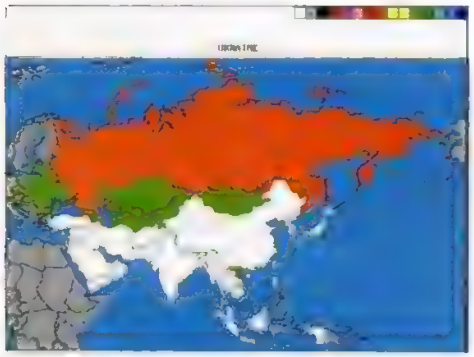
• *List Price: QL 3002, $2,995. Cubix Corp., 2800 Lockheed Way, Carson City, NV 89706; 702-883-7611.*

Circle 405 on reader service card

IMPROVED

Will the World Stand Still so We Can Ship Our Product?

It was hard enough to be a map maker when the Berlin Wall came down, but then the Soviet Union broke apart. Fortunately, it's easier to update software than it is to update globes.



The way it is...at press time, anyway.

PC Globe, Version 5.0, is here. Eighteen new countries have been added to the updated and expanded "electronic atlas" software package, including the Baltic States, the Commonwealth of Independent States, Croatia, Slovenia, and the Yugoslav Federation. The latest version contains improved country comparisons using bar charts and thematic maps. Bar charts no longer confine users to 11 countries. Instead, you can page through every one in the package. When you work with thematic maps, cursor movement over the countries displays different statistics relating to the selected category.

• *List Price: PC Globe, Version 5.0, $69.95. PC Globe Inc., 4440 S. Rural Rd., Tempe, AZ 85282; 602-730-9000.*

Circle 406 on reader service card

BRIEFS

Graphic Cards

Actix Systems has unveiled the GraphicsEngine 70 ($349), a 70-MHz Windows accelerator card. The unit promises to increase video processing speeds in graphics-intensive applications and supports resolutions of 640-by-480, 800-by-600, 1,280-by-1,024, and 1,024-by-768 in both normal and HiColor modes. 800-927-5557, 408-986-1625.

Ahead Systems is shipping the Ahead Graphics eXtension (AGX) Display Adapter ($699), a SuperXGA adapter for IBM PS/2 Micro Channel and compatible PCs. The unit features an on-board 32-bit coprocessor and provides a maximum resolution of up to 1,024-by-768 noninterlaced. 510-623-0900.

American Megatrends' Fast View EISA SVGA add-in card ($450) is designed to increase video processing speeds for EISA-based PCs. The card provides standard VGA resolutions and supports Super VGA enhanced and extended modes up to 1,024-by-768 with 265 colors and 1,280-by-1,024 with 16 colors, interlaced. 800-828-9261, 404-263-9381.

CUI has unveiled the CEG (Continuous Edge Graphics) Turbo FX color graphics adapter ($225), supporting up to 792,096 colors. The unit's software drivers use anti-aliasing techniques to smooth the jagged edges of fonts and vector graphics onscreen. 800-458-6686, 408-241-9170.

Focus Information Systems' 2the Max VGA GUI6000 graphics accelerator card ($299) offers 512K of VRAM and ships with software drivers for graphics-intensive applications such as AutoCAD and Ventura Publisher. The unit provides resolutions from 640-by-480 with 65,536 colors up to 1,024-by-768 with 16 or 256 colors—both interlaced and noninterlaced. 510-657-2845.

NEW

Presenter Makes Graphics, Multimedia Accessible

Using a new graphics technology called "constraint management," SoftCraft Presenter, Version 1.0, applies the concepts of a spreadsheet program to graphics objects. According to **SoftCraft,** the Windows-based package lets users create slides, overheads, or animated multimedia presentations. Presenter uses DDE (dynamic data exchange) to produce graphs from spreadsheet data. Graphs and clip-art images can be animated and exported into the standard Windows animation format. It also includes a multimedia interface, letting users add sound and video clips via Windows Multimedia Extensions or Windows 3.1.

The package provides users with a wide range of the stylesheets, drawing tools, and slide templates found in traditional presentation graphics packages, as well as a collection of business-related clip art.

• *List Price: SoftCraft Presenter, Version 1.0, $595. SoftCraft Inc., 16 N. Carroll St., #500, Madison, WI 53703; 800-351-0500, 608-257-3300.*

Circle 407 on reader service card

NEW

Ink Jet Printer Saves Desktop Space, Fits in Your Briefcase

On the desktop, **Eastman Kodak Co.**'s Diconix 701 ink jet printer provides reliable printing in a compact unit. As a portable, running on a camcorder battery pack, the

The World Standard

First Edition ★★★★★ Everything you've been missing

HIDDEN PLOTS DISCOVERED

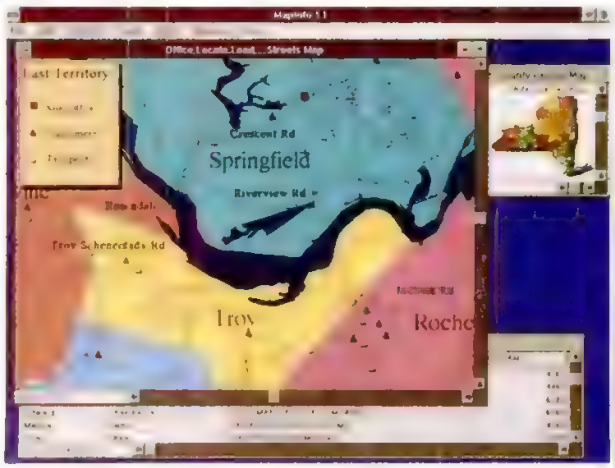
Desktop Mapping Held Responsible

For years organizations have had to rely on spreadsheets and other data analysis techniques to interpret information. But apparently, they've been missing a lot. The new technology of desktop mapping is revealing just how much.

As spokesmen at MapInfo,® the leader in desktop mapping, put it: "By advancing relational database technology to incorporate data with maps, MapInfo has produced a breakthrough in analysis capabilities. It is literally 'showing' its users patterns, relationships and trends that they never knew existed.

"In the process, it's allowing them to understand and present information more quickly, clearly and thoroughly. It's helping them deploy their resources more realistically and profitably. It's showing them how to target customers, service territories and optimize sales. It's helping them plan land use, select site locations, and efficiently manage facilities and operations.

"In a word, it's allowing them to visualize and take advantage of options and opportunities that other data analysis techniques simply can't show."



With MapInfo, you can overlay data from dBASE (DBF), Lotus 1-2-3, Excel, delimited ASCII, plus many other formats, and relate it to thousands of maps, down to street level on Windows, DOS, Macintosh, Sun and HP.

Free Demo Disk Tells Inside Story

It's called *Desktop Mapping The MapInfo Way.* Our reviewers call it the premier guide to discovering what's hidden inside your data.

To qualify call **800-358-7676 x30**, or Fax 518-274-0510 for your copy. Then stay tuned for more good news from The Standard On The Streets.

MapInfo™

The Standard On The Streets

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CIRCLE 291 ON READER SERVICE CARD

WHAT GOOD IS POW

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Introducing the first 486SX notebook with TFT color.

You are about to witness an incredible display of power.

Introducing the Toshiba T4400SXC. The first notebook to offer you all the power of a 486SX with all of the jaw-dropping possibilities of TFT LCD active matrix color.

Consider that with its active matrix Super VGA color screen, the T4400SXC can actually display a kaleidoscope of 256 simultaneous colors at a 640 x 480 pixel resolution.

Remarkably, these 256 colors can be drawn from a palette of 185,000 colors to give life to photographic images and color intensive presentations. It's enough to make your retina want to take a vacation.

Not to mention that each pixel on the screen is controlled by three individual transistors, ensuring perfect focus and color registration. The result is amazing clarity far superior to desktop monitors and a brighter, faster screen that far exceeds passive matrix LCD color screens.

Combined with a blazing 25MHz, 486SX microprocessor and 8K internal cache, it's powerful enough to handle your wildest visions.

Of course, you shouldn't be limited by the number of ideas you have either. Which is why the T4400SXC is equipped with a 120MB hard drive for plenty of storage. And 4MB of RAM expandable to 20MB.

And since ideas happen anywhere, any time, we've designed it to fit in half of a briefcase and given it a Nickel Cadmium battery that lasts 3 hours per charge.

Of course, there are times like payday when it is necessary for you to be in the office. Which is why we made our new notebook to be expandable with our Deskstation IV, giving you two expansion slots, and ports for external monitor and external keyboard.

intel inside

Naturally, this is all just the tip of the iceberg, so call us at 1-800-457-7777 for more information.

We think you'll find that when it comes to the future of personal computing, Toshiba has incredible vision.

In Touch with Tomorrow

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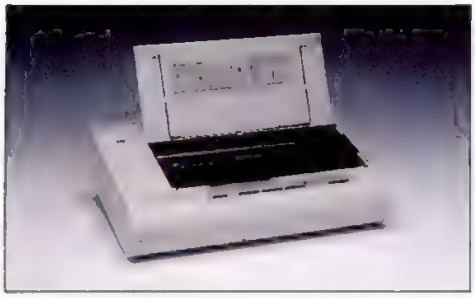
CIRCLE 379 ON READER SERVICE CARD

701 provides up to 100 pages of continuous printing on a single charge.

Weighing in at just under 6 pounds with battery, the 701 offers a 300- by 300-dot-per-inch print resolution and output rates of 200



PHOTOGRAPH BY THOM O'CONNOR

The Diconix 701: compact and reliable.

characters per inch (3 pages per minute) in draft mode and 120 cpi (2 ppm) in quality mode. The unit has two built-in printer emulations (Hewlett-Packard DeskJet Plus and IBM Proprinter X24E) and includes an internal font-rotation feature that allows stored portrait-oriented fonts to be rotated into landscape mode. A built-in sheet feeder holds up to 30 pages of plain paper.

• *List Price: Diconix 701, $549. Eastman Kodak Co., Printer Products Division, 343 State St., Rochester, NY 14650; 800-344-0006. Circle 408 on reader service card*

IMPROVED

AutoSketch Comes to Windows

Autodesk's AutoSketch for Windows is designed to offer an illustration, architectural drafting, and engineering drawing solution for the Windows environment. The package contains a configurable toolbox and a collection of SketchTools (custom toolboxes, icons, and macros).

AutoSketch ships with more than 2,000 symbols, 50 pattern fills, 20 text fonts, multiple layers, scalable type lines, and a palette of 256 colors. It offers CAD-like features such as associative dimensioning, and a full set of measurement tools. Drawings are displayed in decimal units accurate to six places, or in feet and inches. AutoSketch for Windows supports OLE and the .DXF file format for importing and exporting material from CAD programs such as AutoCAD.

• *List Price: AutoSketch for Windows, Version 1.0, $299. Autodesk Retail Products, 11911 N. Creek Pkwy. South, Bothell, WA 98011; 800-228-3601, 206-487-2233.*
Circle 410 on reader service card

BRIEFS

Monitors

Dolch's Prism ($8,495) is a 7-pound color thin-film transfer (TFT) display that functions as both a standalone monitor and an overhead projection panel. Using a proprietary backlight cartridge, the Prism offers full-motion display in a compact housing. The unit has a range of up to 185,000 colors, says the company. 800-538-7506, 800-223-2077 (California only), 408-957-6575.

Hitachi Group's Nissei Sangyo America has unveiled two new multiscanning color monitors for Windows users. The 15-inch SuperScan 15 ($799) supports resolutions of up to 1,024-by-768 noninterlaced. The 17-inch SuperScan 17 ($1,495) supports resolutions of up to 1,280-by-1,024. SuperScan monitors feature flat screens and comply with low-emission standards. 800-441-4832.

Nanao is shipping three new additions to its Flexscan series of color monitors, featuring the company's Saddle/Saddle Deflection Yoke to reduce emission of low-frequency magnetic fields.

The 14-inch Flexscan 9065S ($899) supports a maximum resolution of up to 1,024-by-768 noninterlaced.

The 17-inch Flexscan F550i ($1,749) supports a maximum resolution of up to 1,280-by-1,024 noninterlaced and features a flat screen.

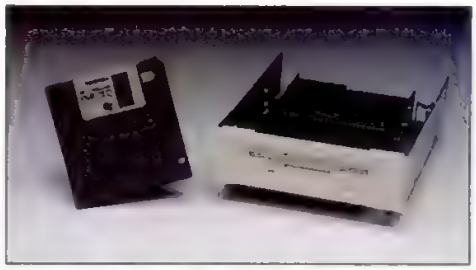
The 20-inch Flexscan T660i ($3,999) supports a maximum resolution of up to 1,600-by-1,200 noninterlaced. Both units store up to 32 user-defined screen configurations and display modes. 310-325-5202.

Optiquest's 17-inch flat-screen 4000D ($1,495) supports a maximum resolution of up to 1,280-by-1,024 noninterlaced, and provides 16 preset and 16 user-defined resolution modes. 310-948-1185

NEW

GSI Ships 2.88MB "Super-Floppy" Upgrade Kit

GSI is shipping a 2.88MB extra-high-density floppy disk controller that requires no special BIOS upgrade or software drivers. The Model 11 2.88MB "Super-Floppy" upgrade kit consists of a Model 11 floppy disk controller, a TEAC 2.88MB floppy disk drive, a Toshiba 4MB floppy disk, and ribbon cabling.



PHOTOGRAPH BY THOM O'CONNOR

Break the 1.44MB barrier with a "Super-Floppy."

The Model 11 installs as a secondary controller and lets users connect up to four floppy disk drives, including the TEAC 2.88MB drive, and has an on-board BIOS that lets the user reassign drive letters.

• *List Price: Model 11 2.88MB "Super-Floppy" upgrade kit, $325. GSI, 17951 H Sky Park Circle, Irvine, CA 92714; 714-261-7949. Circle 409 on reader service card*

NEW

Peer-to-Peer Networking That Might Part the Red Sea

Moses Computers has unveiled MosesAll!, plug-and-play peer-to-peer network operating system software that ships with a network card. The $99 entry-level package lets users build a network on one PC at a time.

MosesAll! includes a 2-mbps network card, a single copy of MosesNOS, Version 3.0 (peer-to-peer network operating software), and 25 feet of standard telephone cable. It supports up to eight PCs for application sharing and printing.

• *List Price: MosesAll!, $99. Moses Computers, 15466 Los Gatos Blvd., #201, Los Gatos, CA 95032; 408-358-1550.*
Circle 412 on reader service card

At Okidata® one good thing

OL400

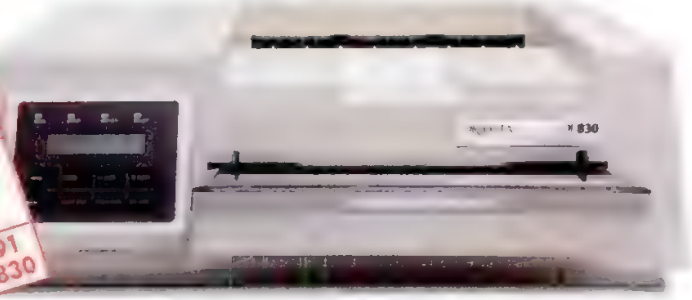
4 PPM

PC MAGAZINE EDITORS' CHOICE JUNE 12, 1990 OKIDATA OL400

leads to another.

OL830

PC MAGAZINE EDITORS' CHOICE NOV. 26, 1991 OKIDATA OL830



8 PPM

When Okidata's OL400 personal page printer won a PC Magazine Editors' Choice award, the editors praised its overall performance, noting its high graphics and text quality and wide selection of built-in typefaces and fonts. And they pointed out that it had the lowest suggested list price of any page printer then available.

When Okidata's new OL830 Adobe® PostScript® printer won the same coveted award, the editors once again praised our printer's overall performance. They named it fastest of all 8-ppm printers tested in PCL (HP emulation) graphics mode. And they rated it "the best inexpensive PCL/PostScript printer available".*

Both printers offer full HP Series II software compatibility, and the industry's only 5-year printhead warranty. Plus a choice of options to tailor either machine for your specific business or home-office application.

Call 1 (800) OKIDATA for the name of your nearest Okidata dealer, and ask him to show you both of our award-winning page printers.

OKI OK! OKIDATA OK!

We don't just design it to work. We design it to work wonders.®

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CIRCLE 235 ON READER SERVICE CARD

NEW

Delrina Unveils Fax Software for The DOS Environment

Delrina Technology, makers of the popular WinFax PRO, is shipping DosFax PRO, Version 1.0, a memory-resident program that captures print output and sends it out as a standard Group III fax image. This is a DOS version of WinFax PRO; the packages share many of the same features and functionality.

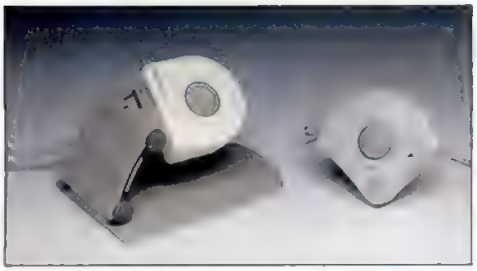
DosFax PRO provides full keyboard and mouse support and functions with both text- and graphics-based applications. It includes scheduling and fax broadcasting features, allows attachment of documents from applications, and functions with any Senfax-, Class I–, or Class II–compatible fax modem.

• *List Price: DosFax PRO, Version 1.0, $79. Delrina Technology Inc., 895 Don Mills Rd., 500-2 Park Centre, Toronto, Ontario, Canada M3C 1W3; 800-268-6082, 408-363-2345.*
Circle 411 on reader service card

NEW

New Trackball Stands Up for Itself; Another Hits the Road

"Stand in the place where you work." **Microsoft**'s BallPoint Mouse does just that. The popular little trackball and optional laptop clip that have been spotted on coast-to-coast flights are ready to come in for a landing. Now bundled with an extension cable and an adjustable desktop stand, the BallPoint Mouse is a fully functional desktop pointing device for both right- and left-handed users. Those who have a BallPoint Mouse can get the desktop stand for $10.



PHOTOGRAPH BY THOM O'CONNOR

The Ballpoint with stand, and the NewPoint.

Mouse Systems Corp. has unveiled the NewPoint mini-trackball, small enough to travel along with your laptop but flexible enough to remain on the desktop. The unit features an opto-mechanical tracking system and provides a base resolution of 200 cpi. Mouse Systems ships the NewPoint with its ballistic driver software, offering resolutions from 20 cpi to 6,400 cpi.

• *List Price: Microsoft BallPoint Mouse (bundled with desktop stand and extension cable), $165. Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400.*
Circle 413 on reader service card

• *List Price: NewPoint, $129.95. Mouse Systems Corp., 47505 Seabridge Dr., Fremont, CA 94538; 510-656-1117.*
Circle 414 on reader service card

BRIEFS

Multimedia and CD-ROM

Leading Edge is now shipping four multimedia systems.

The CD2208C ($2,399) and CD2213C ($2,499) systems are 386SX-based PCs running at 20 MHz, featuring 84MB and 130MB hard disks, respectively. Each unit ships with an internal CD-ROM drive, 2MB RAM, dual floppy disk drives, an audio card, a mouse, speakers, and MPC and CD-ROM titles.

The MPC-compliant CD5213C ($2,999) and CD5221C ($3,299) "Multimedia Minitowers" feature 386DX processors running at 33 MHz, with 130MB and 210MB hard disks. They are configured similarly to the desktop units. 508-836-4800.

Tandy has unveiled four new multimedia PCs featuring the company's audio adapter, as well as its Multimedia Upgrade Kit.

The Tandy 2500 SX/25 Multimedia ($1,999.95) is a 386SX-based system running at 25 MHz. It has an internal MPC-compatible CD-ROM drive and an 85MB hard disk.

The Tandy 4825 SX Multimedia ($2,799) is a 486SX-based system running at 25 MHz. It has a 120MB hard disk.

The Tandy 4850 EP Multimedia ($3,499) features Intel's 486DX2 speed-doubling chip. It has a 120MB hard disk.

The Tandy 4833LX/T Multimedia ($4,499) is a 486DX-based tower system running at 33 MHz. It has a 120MB hard disk.

The Tandy internal Multimedia Upgrade Kit ($799.95) includes an MPC-CD-ROM drive, an audio adapter, and multimedia software. For more information, contact your local Radio Shack.

IMPROVED

Start Working Exactly Where You Left Off Last Time

Powercard Supply's PCResume, Version 5.0, an auto-resume utility, allows you to stop while in the middle of several applications, press a hotkey, shut down the system, and walk away. The utility automatically freezes your applications and saves the information to the hard disk.

This nifty utility lets you resume working the next day without having to reload and open applications and files. The device driver occupies a mere 7K of memory and stores system and application data to the hard disk at a rate of between 2 to 5 seconds per megabyte, according to the company.

• *List Price: PCResume, Version 5.0, $49. Powercard Supply L.C., 12231 SW 129th Ct., Miami, FL 33186; 800-637-2797.*
Circle 415 on reader service card

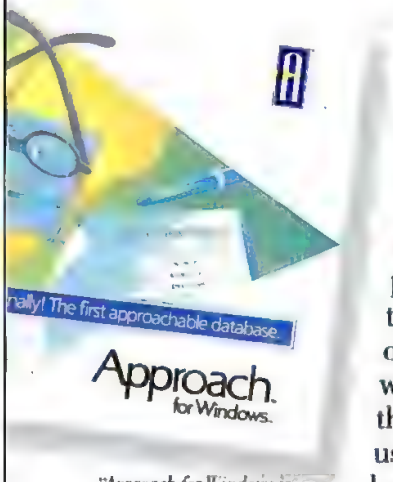
IMPROVED

PhotoStyler Update Ships

Aldus Corp.'s color image-processing program, Aldus PhotoStyler, Version 1.1a, now includes support for raw-image data formats and for the JPEG standard of image file compression and expansion. The update offers optimized memory management, faster image handling, TIFF LZW compression and decompression, and clipboard operations.

• *List Price: Aldus PhotoStyler, Version 1.1a, $795; free to registered users of Version 1.0 (206-628-2320). Aldus Corp., 411 First Ave. South, Seattle, WA 98104; 206-622-5500.*
Circle 416 on reader service card

This Approach Eliminates All Barriers To Databases.



"Approach for Windows is an amazing product with features galore...No other Windows database to date is as powerful or easy to use... You'll be as wowed by it as we were," says PC Computing.

For many of us, running a database is like running an obstacle course. If it has any relational power at all, you'll get snagged on programming. If you want to share information with other databases, you'll hit a wall. And, of course, there's the hurdle of using a database over a network.

Now someone's figured out a way around all this. Fittingly, it's called Approach™ for Windows™—a remarkable new Windows database. The first truly *approachable* one. And the only one that's both a stand-alone database—with its own relational engine—and a front-end to other data.

Approach is so easy anyone can use it. It takes just minutes to build a new database or produce a professional report. You'd expect that from a database with this much speed. One that includes a tightly integrated, built-in forms design package with extensive graphics tools, a slew of turnkey business templates, and a report generator.

Everything you need to harness relational power. Even the power to link up to 10 databases simultaneously.

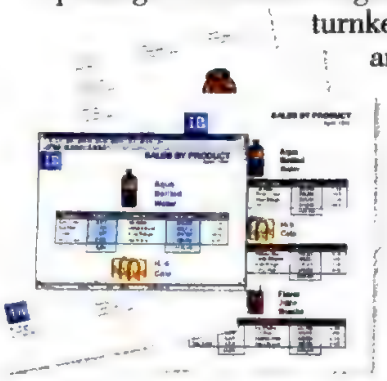
Something else you can harness is existing data. Approach is built for superb client/server performance from the ground up. Using our exclusive PowerKey™ technology, you get something previously unheard of: 100% compatibility with dBase®, Paradox®, or Oracle® SQL data.

BEST OF COMDEX/Spring '92 BYTE
Best Software Winner

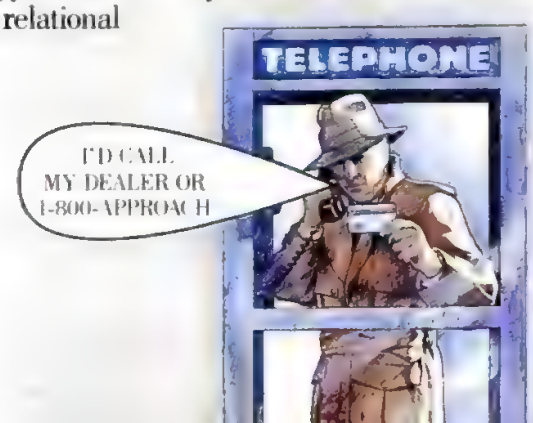
Break through the barriers of Windows databases. "Approach proves you can deliver a high performance relational database anyone can use," lauds Technical Director J. Diamond of the Windows User Group.

Since Approach is also 100% network compatible (no set-up required), you can access, manipulate, mix, update, and report on information while others work on the same file, in either Approach or the native application.

So call us at 1-800-Approach or see your local dealer. Because if you want the database path of least resistance, there's only one Approach.



We've bottled all the graphics and layout tools you'll need. So even a first-time user can produce professional reports in minutes.



APPROACH
SOFTWARE CORPORATION

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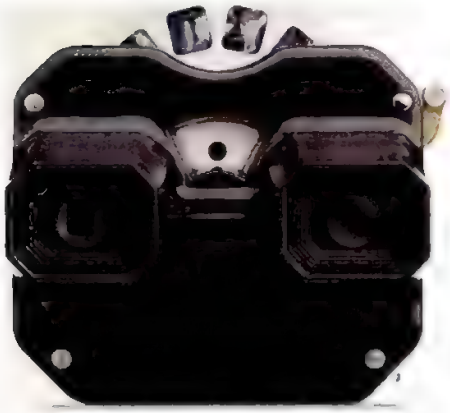
CIRCLE 100 ON READER SERVICE CARD

The standard is now



Why waste time retrieving a file, only to find that it wasn't the one you wanted? Only 1-2-3 has the Viewer technology that will let you quickly preview files before retrieving them.

Insert a column simply by clicking a SmartIcon. What would Plato have thought?

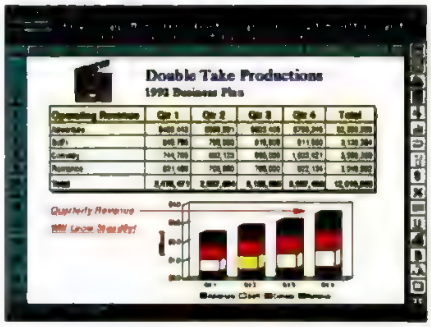
With Auto Compress, you can squeeze an entire worksheet on one printed page...automatically. Or use its manual mode to adjust a worksheet to fill a page in its entirety.

Need to quickly get a closer look at the logic behind the formulas you created? The Auditor breaks it all down for you in no time.

How quickly can you determine what your sales quotas must be if your objective is to achieve a specific revenue amount? With Backsolver, you'll uncover the answer faster than you can say, "what if."

Introducing Lotus 1-2-3 for DOS Release 2.4. with SmartIcons

Shift gears for a moment. And imagine a Lotus® 1-2-3® for DOS spreadsheet that's, well, very Windows-like. With many of the snappy features our Windows™ applications have to offer. Along with unique 1-2-3 features like SmartIcons, Backsolver, the Auditor and Viewer. What you have is the new Lotus 1-2-3 for DOS Release 2.4. What it offers you is a taste of a graphical, WYSIWYG environment. Without the hardware and training costs associated with moving to Windows.



We've always been the fastest graphical spreadsheet for DOS. Now we're also the easiest to use.

For starters, 1-2-3 for DOS is the only DOS spreadsheet that offers SmartIcon

*Please have your credit card and product package ready when you call. In Canada, call **1-800-GO-LOTUS.** ©1992 Lotus Development Corporation. All rights reserved. Lotus and 1-2-3 are registered trademarks

available in automatic.

Over 60 SmartIcons™ come with this new version of our DOS spreadsheet. Each helps you speed things up by giving you convenient, one-click access to your most common tasks. You can also create your own short-cuts by attaching a macro to any of the program's 12 customizable SmartIcons.

Ready to print? Just click here.

Turn text to bold in an instant.

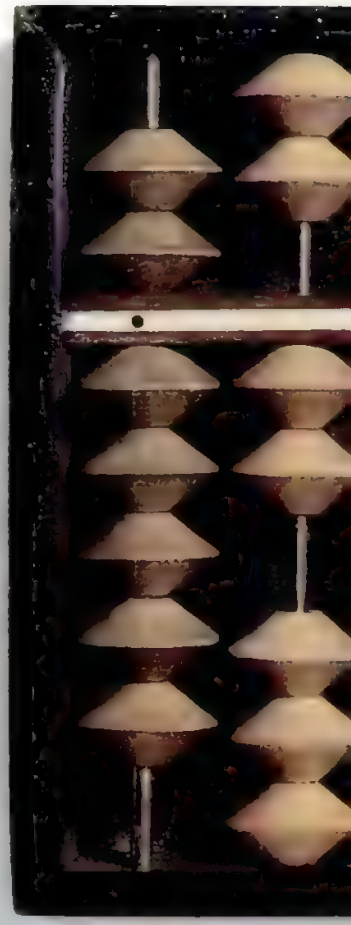
A QuickGraph in one quick step.

Have it your way with customizable icons.

Center text across columns the easy way.

Change font colors in no time.

The more you work, the more you save. Files, that is. So we offer you one-click access to the Save feature. Which, of course, saves you time.



Click on the SmartIcon with the dollar sign and you'll immediately set your selection to currency.

Forget about more traditional ways of summing up columns and rows. Instead, click the SmartSum icon and you'll get right to the bottom line.

technology. The program comes with a palette of 75 icons, 12 of which are customizable, giving you one click access to nearly all of its features and functions. Not to mention a quicker way to work. Of course, if there's a 1-2-3 for Windows or 1-2-3 for Macintosh® user you share files with, don't worry. We've made it compatible with them all.

The way we look at it, there are over 14 million people out there committed to 1-2-3 for DOS. We want them to know we're just as committed. Which is why we've turned the spreadsheet standard into something you'll appreciate automatically.

For more information about 1-2-3 for DOS Release 2.4 or to order your upgrade,* call **1-800-TRADEUP, ext. 6757.** Or see your Lotus Authorized Reseller.

Lotus 1-2-3 for DOS

For information on registering for LotusWorld™ '92, call 1-800-524-1857.

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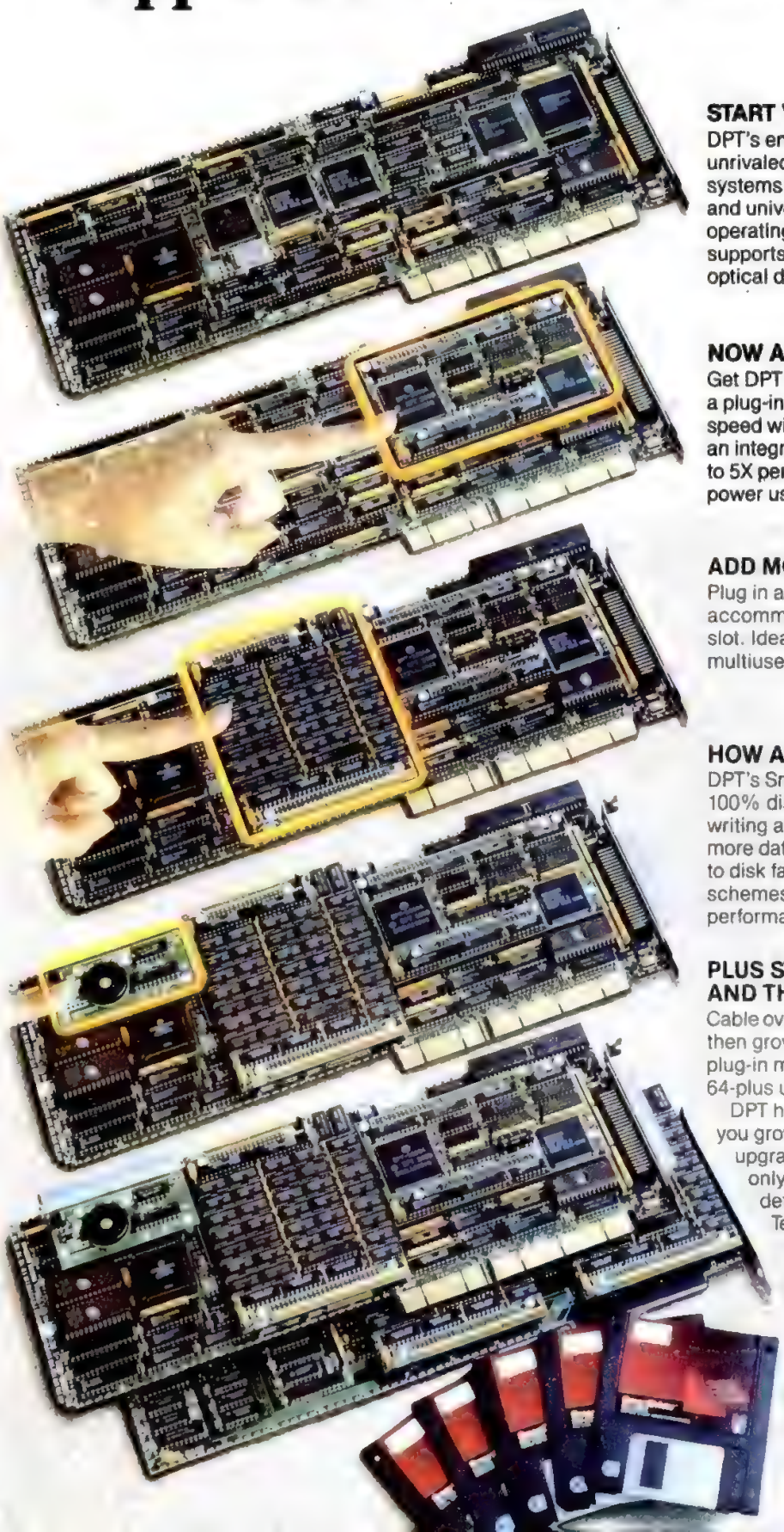
SmartCache™ Plus: the grow-as-you-go approach to SCSI controllers



START WITH THE BEST...
DPT's entry level SmartCache Plus board offers unrivaled price/performance for single-user systems. It features ISA or EISA bus mastering, and universal SCSI disk compatibility for all PC operating systems. SmartDriver software supports SCSI-2 peripherals like tape and optical drives.

NOW ADD CACHING!
Get DPT's award-winning caching technology in a plug-in module! Move up to disk caching speed without investing in a new controller. With an integral 512K cache, the module provides up to 5X performance gains for workstations, power users, and small multiuser systems.

ADD MORE USERS, ADD MORE CACHE!
Plug in a 2 MB or 4 MB memory module and accommodate up to 18 users from a single card slot. Ideal for medium-sized networks or multiuser systems.

HOW ABOUT DISK MIRRORING?
DPT's SmartCache mirroring module provides 100% disk fault tolerance by simultaneously writing all data to a second "mirrored" drive. No more data loss or costly system down-time due to disk failures. And unlike software mirroring schemes, fault tolerance is achieved with no performance penalties.

PLUS STILL MORE CACHE, AND THEN SOME...
Cable over to DPT's 4 MB Cache Expansion Card, then grow your system to 16 MB by adding more plug-in memory modules—enough power for 64-plus users!

DPT has your solution—no matter how you grow. Performance, compatibility and upgradability make SmartCache Plus the only SCSI controller you'll ever need. For details, contact Distributed Processing Technology, 140 Candace Drive, Maitland, FL 32751. Phone (407) 830-5522; FAX (407) 260-5366.

DPT

CIRCLE 355 ON READER SERVICE CARD

Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Carol Levin

Collection of DOS Advice Is Next-Best Source (After Real-Live Power User)

BY JONATHAN MATZKIN

A knowledgeable friend or colleague is probably the best source of DOS erudition. Not everyone, however, is fortunate enough to benefit from the accumulated wisdom and sound advice of a real live power user. Kay Yarborough Nelson's *Voodoo DOS: Tips and Tricks With an Attitude* may be the next-best thing for users who want to sharpen their skills.

Voodoo DOS is not intended to cover DOS comprehensively. Instead, the author focuses on a variety of topics and techniques that will boost the fluency and productivity of users who study her suggestions. Since some of the material is presented in a cursory manner, basic knowledge of DOS is a prerequisite. For the more advanced user, *Voodoo DOS* offers a wealth of useful suggestions.

In particular, the chapters on the DOSSHELL program and on batch files are full of clever tidbits. Often ignored by command line veterans who disdain graphical interfaces, DOSSHELL is a good compromise: It can be run in character mode, yet offers Windows-like file management and task switching. Nelson makes a good, concise case for the shell, then leads a tour of its capabilities. But she doesn't advocate abandoning the command line altogether; instead, she offers a clear-eyed assessment of the tasks best suited to both the shell and the C: prompt.

Even sophisticated DOS users will find Nelson's chapter on batch files a real eye-opener. Modest though it may be, the DOS batch language can be quite useful and does have some nimble applications, including ones that can create custom help screens. Nelson carefully spells out some batch files you can use as they are or adapt for other purposes, and explains how to use them in conjunction with DOSKEY to save favorite macros.

Among the excellent suggestions sprinkled throughout is one in which she advocates, for very sound reasons, limiting your AUTOEXEC.BAT file to just a single CALL statement. In the absence of a human resource, *Voodoo DOS* is a good source of wisdom.

Voodoo DOS: Tips and Tricks With an Attitude
by Kay Yarborough Nelson, $19.95, Ventana Press, P.O. Box 2468, Chapel Hill, NC 27515; 800-877-7955, 919-942-0220. ISBN: 0-940087-95-2.
Circle 501 on reader service card

Database Guide Takes Anxiety Out of Learning And Mastering Paradox

BY SAL RICCIARDI

Database management packages are a test for beginners. To pass, you must overcome the arcane terminology and complexity of the software. If you are insecure about facing the challenge of Borland's Paradox, you can relax. Alan Simpson's *Mastering Paradox 3.5* is a thorough and understandable guide for newcomers and experienced database users alike.

Simpson begins with the basics, showing you what fields are and how to create a table and define its structure. By chapter four, you've populated a sample database and are working within Paradox's friendly table metaphor. The author then goes on to cover the basics of using Paradox to edit, store, retrieve, sort, search, print, and graph data. In the chapter on searching, you are introduced to Paradox's very powerful Query-By-Example feature, which lets you ask Paradox for data that matches specific criteria. Throughout, Simpson reinforces concepts with examples and illustrations.

Advanced topics such as multiple tables and correct database design would be difficult were it not for Simpson's adeptness at making complex issues understandable for the novice. Through examples, he explains one-to-one, one-to-many, and many-to-many database designs and how to use common fields to create relationships between tables. And you'll find in-depth treatment of the integration of multiple tables into queries and reports.

While database application programming is beyond the scope of the book, Simpson does include a very capable primer on the Paradox Application Language (or PAL). Here he explores commonly used commands and techniques with the same clarity with which he discusses other topics. For a thorough yet easy-to-read primer on Paradox, you won't be disappointed with *Mastering Paradox 3.5.* □

Mastering Paradox 3.5
by Alan Simpson, $26.95, Sybex, 2021 Challenger Dr., Alameda, CA 94501; 800-227-2346, 510-523-8233. ISBN: 0-89588-677-4.
Circle 502 on reader service card

HP LaserJet IIISi

Forget about pa
Let's talk about

In a series of tests, we compared the QMS-PS® 1700 to the HP® LaserJet® IIISi. The result? In one 8-hour day, we delivered 2½ times more productivity. From the same 17ppm engine.

The reason is our Crown™ architecture. A unique combination of hardware and software that lets the QMS-PS 1700 print one document while receiving and processing another. With no operator intervention. And no lost time.

Our Emulation Sensing Processor (ESP) technology recognizes incoming data streams on any of three ports and chooses the right language. So users don't have to stop and reset the printer.

Only QMS has Crown architecture. Both the 17ppm QMS-PS 1700 and the 20ppm QMS-PS 2000 departmental printer have it.

With Simultaneous Interface Operation (SIO),

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QMS-PS 1700

ges per minute. pages per day.

the QMS-PS 1700 can receive data across standard and optional interfaces, from multiple platforms and multiple networks. Simultaneously.

As a result, this is a real network printer. Not just a printer on a network.

If you'd like to see what a difference our capabilities make, call **1-800-422-2769 ext. 2937.** And we'll send you the full results of our tests against the HP LaserJet IIISi.

And you can see why QMS makes the best printer for your work group. Because we have stacks of evidence to prove it.

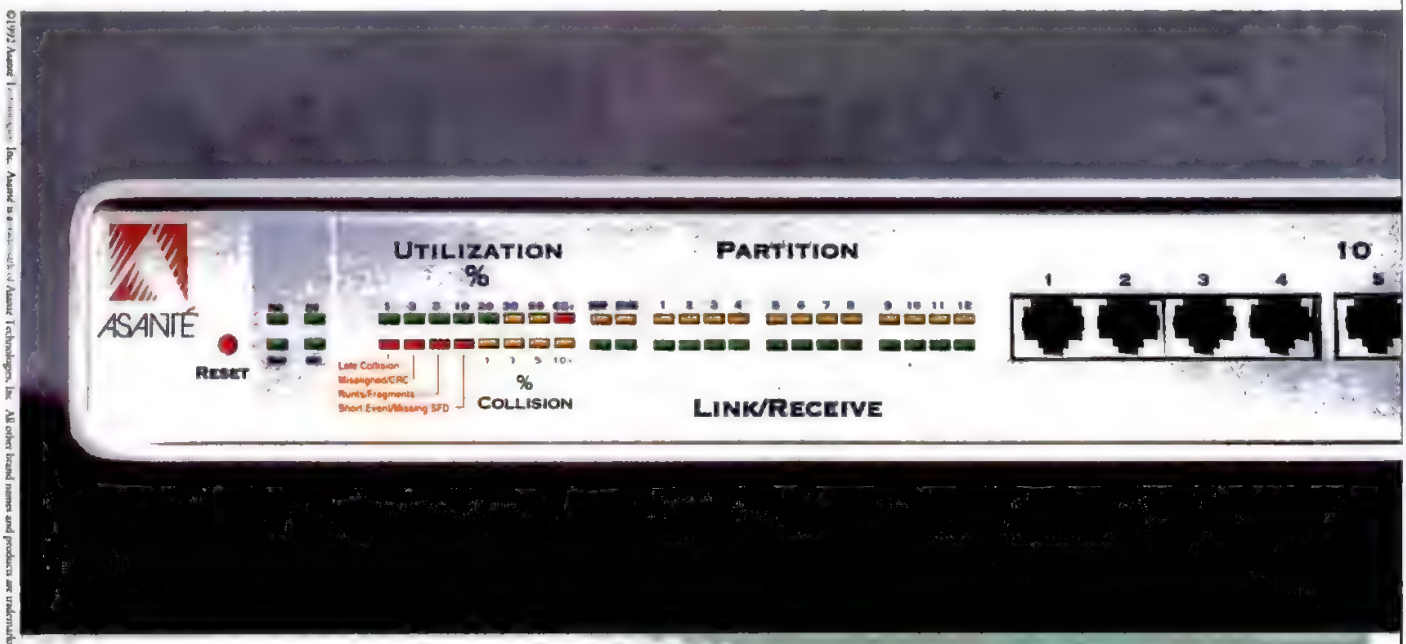
WHY QMS BEATS HP

We'll use the QMS-PS 1700 to print you a copy of these test results. With our Crown architecture, it won't take long.

QMS Finishes First.

QMS®

CIRCLE 259 ON READER SERVICE CARD



We call it a smart hub. You'll call it a smart choice.

The AsantéHub 1012 is a 12-port, intelligent 10BaseT hub that brings enterprise-level hub capabilities to departmental Ethernet networks. Working with AsantéView network management software, it offers power, flexibility and reliability at a very economical price.

Smart Remote Network Management.

Combining the AsantéHub 1012 and AsantéView management software creates the industry's first smart hub with both in-band (SNMP) and out-of-band network management for both PCs and Macs that uses the same graphical user interface.

That means your out-of-band network management is just as powerful as your in-band management. And you can graphically monitor and control individual connections, locally or remotely, from your choice of computer platform.

AsantéView out-of-band management software lets you simultaneously manage up to 12 AsantéHubs which can be distributed up to 2000 feet apart.

AsantéView keeps you in control of your network with performance monitoring windows, a map editing function, multi-level password protection and direct control at the hub and port levels. The software can even be set to trigger your pager whenever certain prespecified events occur. This provides you with

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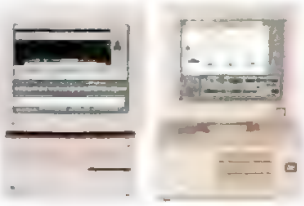
the flexibility to instantly solve your office network problems when you're not there.

Be Smart.
Be Flexible.

To take advantage of the latest technology, the AsantéHub includes a built-in expansion slot designed to accept internetworking option cards. For this slot, Asanté offers the in-band SNMP management module as an option. This allows you to delay the expense of SNMP until you need it.

In addition, the AsantéHub includes a built-in RS-232 port for remote dial-up access, and both RJ-45 and RJ-21 connectors for direct-to-computer or punch-down block connections. There is also a 3-in-1 "13th" port for interconnecting multiple hubs with backbone cabling. This port includes BNC, RJ-45 and AUI connectors supporting a variety of cabling media including thin coaxial, unshielded twisted-pair (UTP) and, with a transceiver, thick coaxial or fiber optic cabling. To maintain network services should the main operating cable fail, this backbone port supports auto-switching redundant cabling with a software override capability.



[Manage your network from a Mac or PC, in-band or out-of-band, all using the same Graphical User Interface.]

[3-in-1 auto-sensing redundant backbone port with software override capability.]

[Remote out-of-band management lets you manage your network from anywhere in the world]

In short, the AsantéHub 1012, combined with AsantéView management software, offers all the features and benefits of a high-end enterprise hub for a departmental price.

Asanté has built a reputation for producing compatible, reliable and flexible networking products. We offer a full family of Ethernet and Token Ring adapter cards for PCs and Macs. And a full line of 10BaseT hubs. We're the networking company of choice because we give you more choices.

Asanté.
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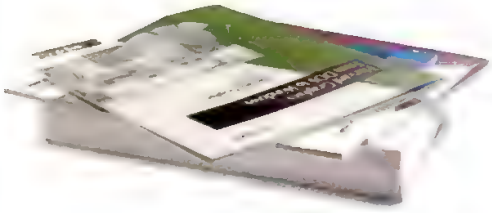

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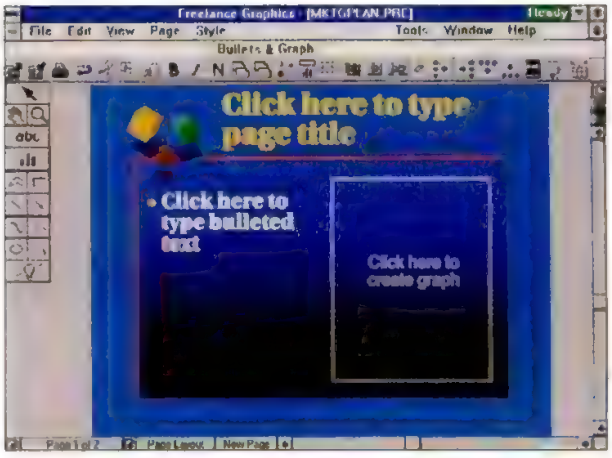

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Toolkits

REVIEWS OF THE LATEST TOOLS FOR THE PC PROGRAMMER

Edited by Trudy Neuhaus

Dis·Doc Professional and Sourcer: State-of-the-Art Disassembly

BY SAL RICCIARDI

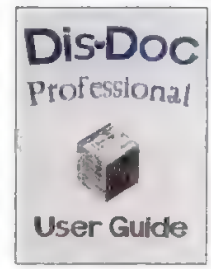
If you've been programming DOS for a while, you may have tried to write a reliable TSR program. To do this successfully, you had to discover a lot of things about DOS that are undocumented. Indeed, many experts have spent hours huddled with DEBUG or Periscope trying to understand the behavior of undocumented DOS features. DOS itself uses some of these interrupt services in programs like PRINT.EXE. One way to discover how these interrupt services work in context is to load up your favorite debugger and trace through a program. But this can be very time-consuming. A better solution is to use a *disassembler*. A disassembler takes a binary executable file as its input and produces assembly language source code.

Dis·Doc Professional (from RJSwantek) and Sourcer (from V Communications) perform a vital service if you need to clarify and document undocumented code, if you've lost the source code for one of your own programs, or if you want to dissect DOS or Windows. And if you suspect that a program contains a virus, you can disassemble it and examine the assembly language source code for suspicious routines.

The disassembly process consists of a series of refinement steps in which you correct and fine-tune the disassembler's decisions about the program being examined. For example, the disassembler may incorrectly treat a code area as data. You can correct this by defining the area as code to the disassembler. The biggest difference between Dis·Doc and Sourcer is how you make this correction. With Dis·Doc you can make these changes interactively and they're reflected instantly. With Sourcer, you must specify your changes via a definition file and then rerun the disassembly step.

Dis·Doc's interactive mode lets you make changes to the disassembly via a full-screen editor of sorts. As you page through the listing, you can enter descriptive labels. The changes you make are propagated throughout the listing. You can experiment by taking a section of code that looks wrong and viewing it as data, or vice versa, to determine what it is. You can also search for questionable conditions such as code labels in a data area or invalid opcodes. You can quickly jump between the hex display mode and the disassembly. The product also supports a batch mode like Sourcer's. With this, you can generate and edit definition files, but Dis·Doc's interactive mode is its greatest strength.

Using Sourcer, you make a first run through the disassembly process and then examine the output listing for changes that have to be made. Next, you edit the definition file to make your changes, add comments, include labels, and so on, and then regenerate the listing. This batch-mode process can be time-consuming, but Sourcer's output listings are beautiful. Both products automatically include comments in the generated output that identify DOS and BIOS calls, I/O port access, and so on, but Sourcer's comments are more thorough.



Both Dis·Doc and Sourcer can produce a quality disassembly. Dis·Doc can disassemble .OBJ files, and it has OS/2 1.3 and Windows .EXE and .DLL support. However, Dis·Doc doesn't support Windows .VxDs.

V Communications unbundles Windows support into Windows Source, an impressive Sourcer add-in. Windows Source works with Sourcer to support disassembly of Windows .EXE, .DLL, .VxD, and .386 file formats as well as OS/2 1.*x* and Phar Lap 286/DOS Extender files. Also included is a suite of eight utilities designed to provide information useful in disassembling Windows programs and an exceptional 88-page instruction manual on Windows disassembly. Both Dis·Doc and Windows Source automatically document Windows API calls in the generated listings.

Which should you choose? If you're serious about disassembly, both. Dis·Doc's interactive mode can be extremely useful, and Sourcer produces high-quality output, so the two products complement each other. Sourcer combined with Windows Source should be mandatory for looking into Windows programs. Since Dis·Doc catches some things that Sourcer doesn't, and vice versa, using both to produce listings can help you zero in on that perfect disassembly. □

Dis·Doc Professional, Version 4.0
List Price: *$249.95*. Requires: *485K RAM, DOS 2.1 or later. RJSwantek Inc., 33 Spencer Brook Rd., New Hartford, CT 06057; 800-336-1961, 203-489-5335.*

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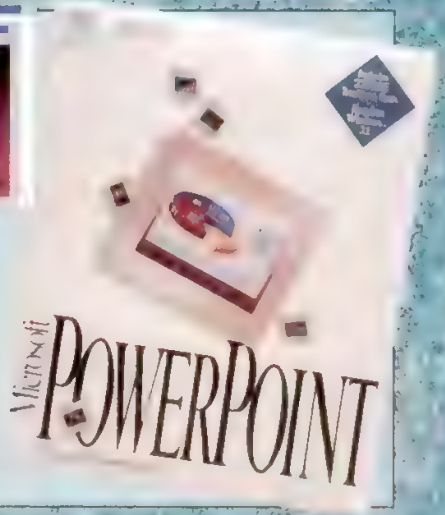

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CIRCLE 302 ON READER SERVICE CARD

Michael J. Miller

Eight Steps to Easier Software

There's great software, and there's Great Software. Colorful icons, pretty pictures, and fancy new features are not virtues when a program is too complicated to run. Let's not even talk about installation routines. Impressive lists of new features make a program stand out in reviews, but developers seem to have forgotten some of the basics.

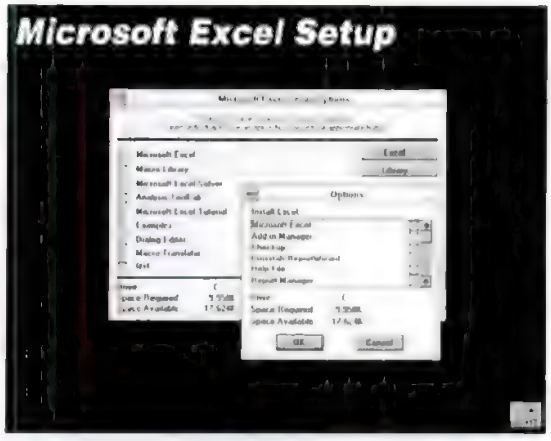
The solution is no secret: Software developers need to focus on the little things that make software easier on the user. Surprisingly, most of these solutions don't even require new technology.

Here's a list of eight features I propose as standard fare for most programs. Four of them make installation much easier and four make programs simpler to run. The suggestions are straightforward. In many cases, DOS programs do them right and Windows programs tend to do them wrong.

1. Selective installation. Today's applications are big. Most word processors, spreadsheets, and graphics programs take 5 to 10 megabytes of hard disk space when installed completely. But the program itself often takes up only 10 to 15 percent of this. The rest is needed by add-on modules, tutorials, help files, import and export filters, and templates.

What are your options if you simply don't have the space on your hard disk? Some programs expect you to install the whole package and then delete the files you don't want. But this doesn't help if you can't fit the program on your disk in the first place. Other programs are more intelligent. They let you select the parts of the program you want to install and tell you ahead of time how much space they take up. It sounds easy, but plenty of vendors—even the big-name ones—don't get it right.

All setup programs should let you install selectively. Microsoft Excel also reports disk space requirements and availability.



Memo to developers: We love great features, but how about mixing in some common sense, too?

2. Smart installation. Most programs today at least look at your available hard disk space and warn you if you're trying to install a program that won't fit. The software should take this a step further and suggest which files to install. Also, it's convenient when upgrades notice that an older version is on your hard disk. Then you can choose either to update the existing program or to install a fresh copy. The software should also tell you how much additional space the program will take up.

3. Courteous installation. Most developers are better about this, but a few still don't get the message: Installation programs should never modify existing files without telling you first. If a program does modify files, then it should make backups. This is particularly important for AUTOEXEC.BAT, CONFIG.SYS, WIN.INI, and SYSTEM.INI files.

4. Smart uninstall. Installing a program is tough enough, but removing it can be nearly impossible. Windows applications are notoriously difficult to uninstall. They tend to put files in multiple directories and modify various .INI files. I'd like to see programs that are intelligent enough to remove these changes when necessary.

This isn't as easy as it sounds, especially since many applications share common components. For instance, you could have a word processor and a spreadsheet that share a spell-checker. If you needed to uninstall the spreadsheet, you wouldn't want the spell-

COLUMNIST PHOTOGRAPHS BY PETER GREGOIRE

ing module to go along with it.

5. Keyboard shortcuts. Nothing beats the speed of Ctrl- and function-key commands. Keyboard shortcuts are one of the great virtues of character-based programs and are often missing from more "modern" GUI programs.

Programs should not require a mouse for every function. All of us who have learned character-based word processing know keyboard shortcuts and like the convenience of bypassing layers of menus. Too many Windows apps and many DOS apps still haven't caught on.

6. Customizable menus and commands. Keyboard shortcuts are a good idea, but like so much else in computing, one size doesn't fit all. Applications and their commands should be customizable, at least offering users the chance to reassign keyboard shortcuts. If you already know WordPerfect commands, you should be able to reconfigure the major editing commands in another word processor so they follow the conventions with which you're comfortable.

You'll find this option in most word processors and a few spreadsheets, but a wider range of applications and features should be customizable. We should have the option to decide which commands appear on which menus and to build icon toolbars that contain the icons we want. Being able to attach macros to menus and button bars would be even better. Again, a few programs do offer this commonsense option, but not enough.

7. Multiple levels of undo. This is one feature that's been very slow in finding its way beyond DOS word processors and a few spreadsheets. In fact, the Windows standard is a simple one-level undo/redo. But there are times when you want to go back several levels. It's only too easy to select some text and accidentally delete and reformat it—all in a couple of quick keystrokes. In this case, a program with only one level of undo would not restore your text. At a minimum, I'd like to see every program that handles text offer a multiple-level undelete function.

8. Data import/export. Most of today's software has absolutely terrible import and export features. Try to move a formatted document from one word processor to another or transfer a worksheet with graphics to another spreadsheet program. It's problematic. Even inserting a drawing into a document can be trying.

One solution is for vendors to publish their file formats. Why not? I applaud groups like the Windows and OS/2 Developers' Association, which is working on making multiple file formats available through the Windows Clipboard, DDE, and OLE. These indirect methods of transferring data would be more useful if vendors could publish multiple file formats. Everyone is talking about programs working together; the least they can do is read each other's data.

To implement most of these proposals, vendors don't have to wait for any breakthroughs in software development. The ideas may be low tech but the payoff is high: Applications will finally be easier for all of us to run. □

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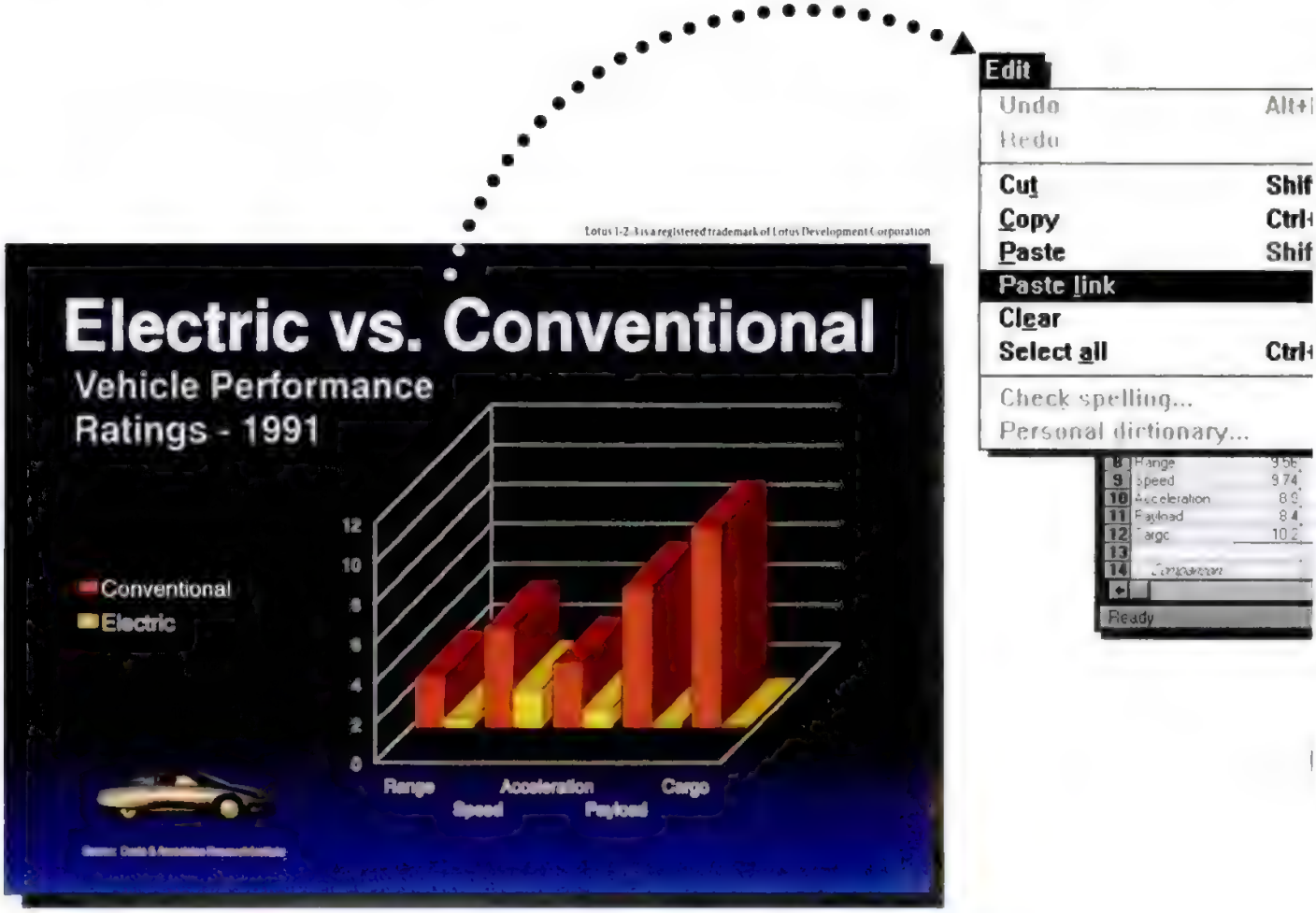

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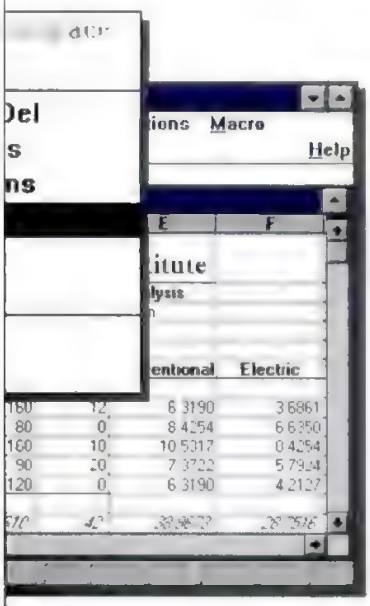

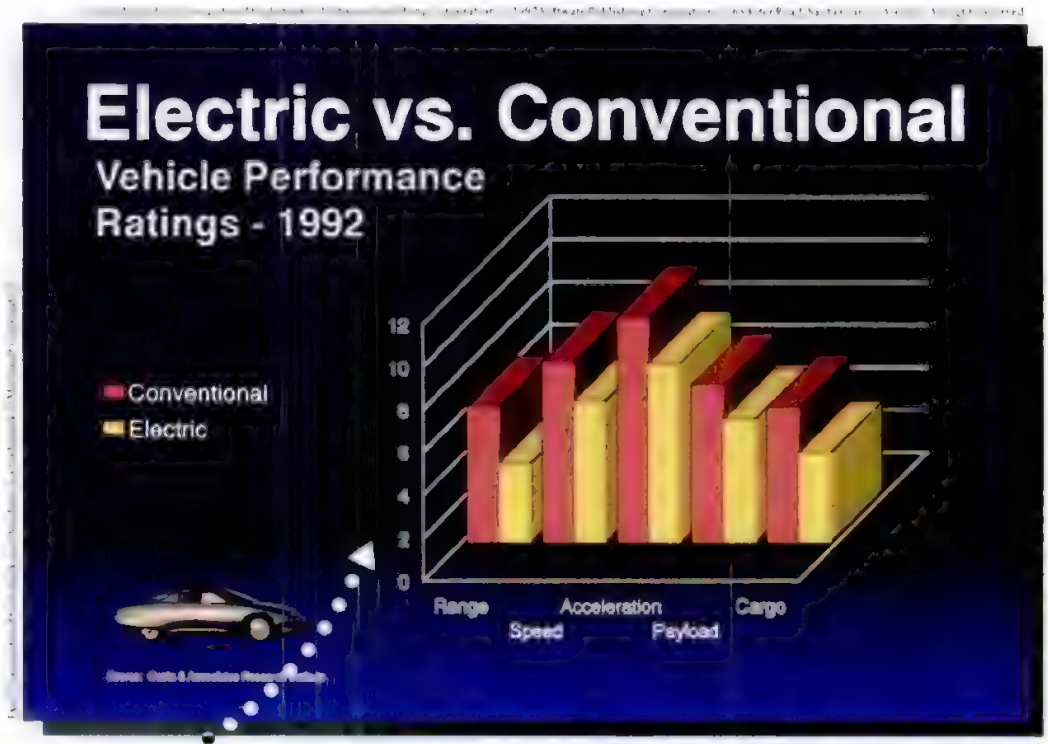

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Bill Machrone

Trivial Pursuits

It was a classic showdown. East versus West. The contest was held in Boston's Park Plaza Castle, a former armory replete with a turret and ramparts, now converted for use as a public gathering place. You could almost see the rockets' red glare.

The Computer Museum stages the annual Computer Bowl, and the event is televised by "Computer Chronicles," the award-winning PBS show. The contestant teams are made up of industry luminaries with a wide range of backgrounds. East was victorious last year, and West was out for revenge. "Computer Chronicles'" Stuart Cheifet moderated; Bill Gates was the examiner, asking the tough questions.

You could feel the tension as West stormed the stage, dressed entirely in black, brandishing huge bottles of Jolt cola. They growled, postured, and high-fived in the worst tradition of bad athletic teams everywhere. East, resplendent in black tuxedos and red bow ties, mounted the stage decorously and nodded sagely to the audience. Moments later, they shattered the decorum as their bow ties began to flash in multicolored profusion.

I was a member of the East Coast team. The pressure was on before an audience of hundreds, while hundreds more were watching via satellite link at Xerox's Palo Alto Research Center and at Microsoft's Redmond headquarters.

The questions were tough. The third toss-up: "According to the movie *2001*, exactly when did HAL start working?" I was amazed that not only did my teammate, Dave Nelson, know the answer—January 12, 1992—but several Westies were gnashing their teeth at having been beaten to the buzzer. Then we breezed through a bonus round, identifying the three major computers discontinued in 1985: DEC's Rainbow, the Coleco Adam, and Apple's farsighted but ill-fated Lisa. At least there were no questions about whether the Lisa had been named after one of Steve Jobs's girlfriends.

East was out front and pulling away. Then West's Jolt cola kicked in. They beat us to the buzzer on a bunch of easy questions, only to break their streak when they misidentified XGA as Extended Graphics Adapter instead of Extended Graphics Array. Gates seldom got the entire question out before the buzzer:

"In 1976, computing history was made when the first Apple I computers were sold. The first batch of Apple I's were sold. . ."

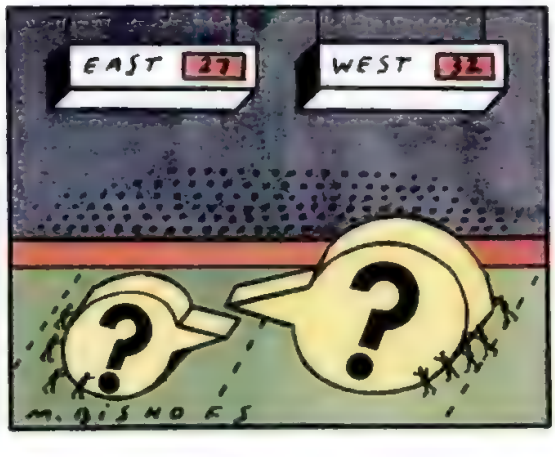
BUZZ!

"West Coast, Vern Raburn?"

"The Byte Shop!"

And so it continued. Battles raged over small details in the answers, such as the word describing a digital computing technology based on the movement of gases or liquids. West answered "Fluidetics," which the judges rejected. East answered "Fluidics," the correct term, which touched off a small Jolt-fueled riot.

It was a fair fight until West got a bonus round, and the topic was the Xerox Alto, a computer developed at PARC for research into GUIs. It so happened that two Westies—John Warnock and John Shoch—had worked on it. They were jubilant. We in the East sat in stunned silence. "What color were the buttons on the Alto's mouse?" I don't know either. Since Xerox probably built fewer than a hundred, you had to have been there to know the



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CIRCLE 008 ON READER SERVICE CARD

Bill Machrone

answer: blue, red, and yellow.

Fresh from that triumphal round, West continued to prove that being slow on the draw makes for a dead cowboy. They out-buzzered us time and again, until we began to suspect a hardware bias in the voting circuit or barbiturates in our drinking water. I finally got a buzz in edgewise, only to blow the question: "Which of the following three characters is invalid in a DOS file name: the dollar sign, the percent sign, or the plus sign?" It was instinct versus intellect. Instinct told me that the plus sign was illegal, but then I started thinking about the way batch files use the percent sign. So I said, "The plu.. No! The percent sign! The percent sign!" To which Stuart Cheifet replied, "The percent sign is incorrect! West Coast, can you take it? The Westies exulted for an indecently long time, then one of them proudly announced, "The percent sign!" We didn't get a point on that round, but at least they didn't either.

It was time for another bonus round. Shaken from my misadventure with reserved characters in filenames, I was wondering what kind of esoterica they'd come up with. Anybody could have answered the three questions correctly:

1. What is the name of the DOS command that finds logical errors in the file system?

2. MS-DOS 3.3 introduced a new command—the CALL command. What does the CALL command do?

3. What does the ERASE command do?

The answers are: 1. CHKDSK, 2. calls another batch file and returns to the calling batch file, and 3. deletes a file. Great, except the official answer sheet and the judges said there is no ERASE command. I asked Gates, "Isn't there an ERASE command in DOS? What am I thinking of?" He shook his head, muttered something, and the contest went on.

Well, Bill, there *is* an ERASE command, and it does just what you think it would. But the difference in the score wouldn't have changed the outcome, and after all, it's just a game.

Wait 'til next time: I'm bringing Jolt cola. □

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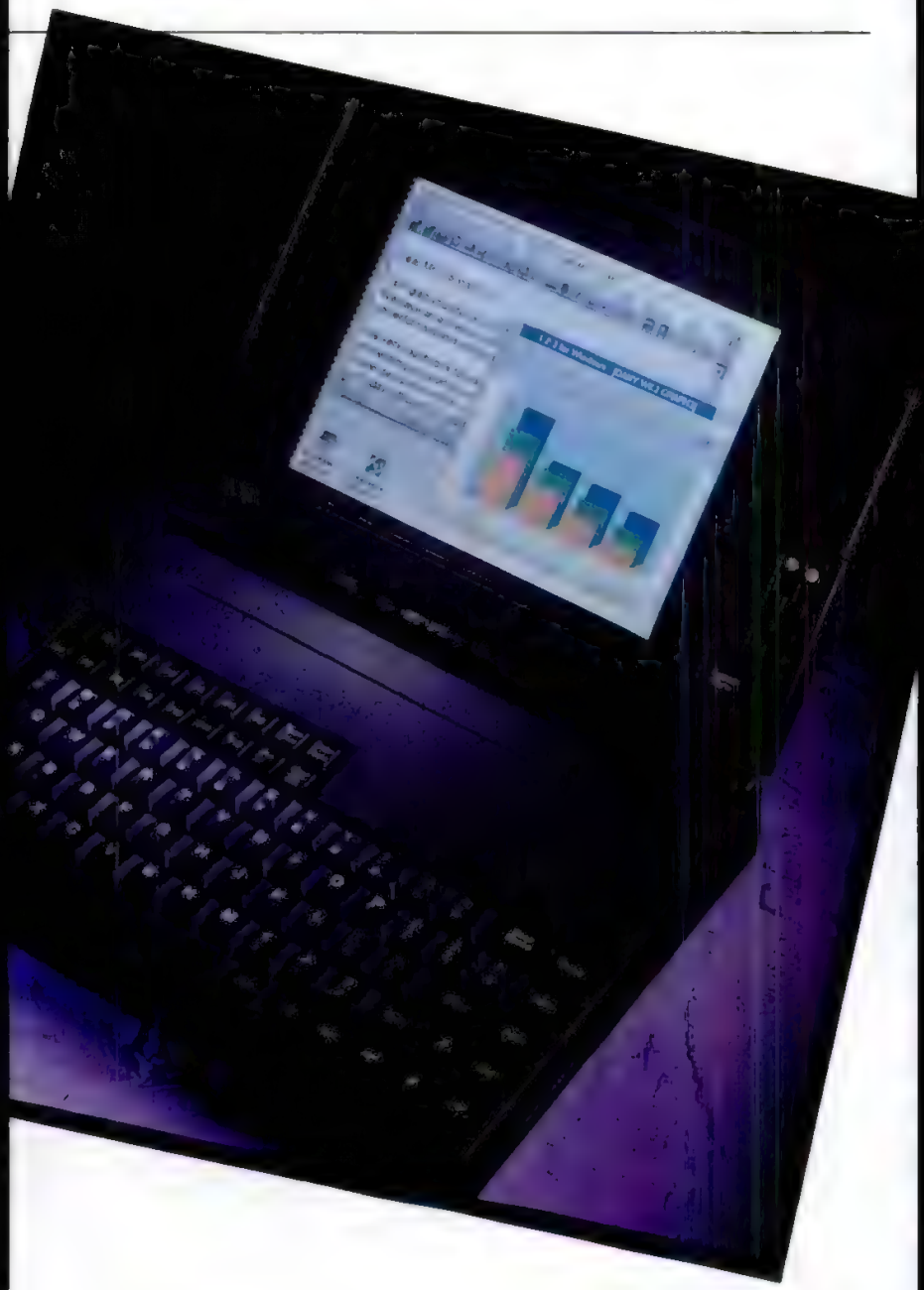

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CIRCLE 060 ON READER SERVICE CARD

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John C. Dvorak

The Platform Shift Is Now

The sooner we recognize that the events of a decade ago closely parallel today's, the better off we'll be. We'll see clearly that Windows and OS/2 are not operating system upgrades. They represent a platform shift as significant as when the original PC was introduced into a world of CP/M machines.

This may seem like an exaggeration, but hear me out. To understand what's about to happen, look back to 1981 when the IBM PC was introduced. There were a number of interesting phenomena at the time, not the least of which was denial. Established users didn't believe that 8-bit CP/M computing was dead and that IBM would have anything to do with the low end of the business. It took about two years before the change was undeniable. Expect the same doubting-Thomas period this time around.

When you look at the early eighties upheaval, you see five variables: a new main processor, a new operating system, a change from 8-bit to quasi-16-bit computing, a bigger address space, and an IBM influence. These same five variables may have clicked into place again. Let's look at them one by one.

First, the new processor. In the first platform shift, we went from an 8080 world where two chips (the Z-80 and the 8080—both running mostly 8080 code) were supplanted by the 8088. The 8088 was an Intel chip that was similar to the 8080 but was actually incompatible with it. Still, an adapter card called the Baby Blue, containing a Z-80 processor, helped users make the transition to the new platform. This kind of interim player is an important part of a platform change. Intel, not wanting to allow some alien chip to be a part of the future platform, altered its designs to allow this transition phenomenon.

Today we see the same phenomenon: two chips—the 8088 and 80286—supplanted by the 80386. As for the Baby Blue phenomenon, the 386 family has real and protected modes. This time, the transitional player is real mode, and its protected mode that opens the door to the future. Baby Blue built-in!

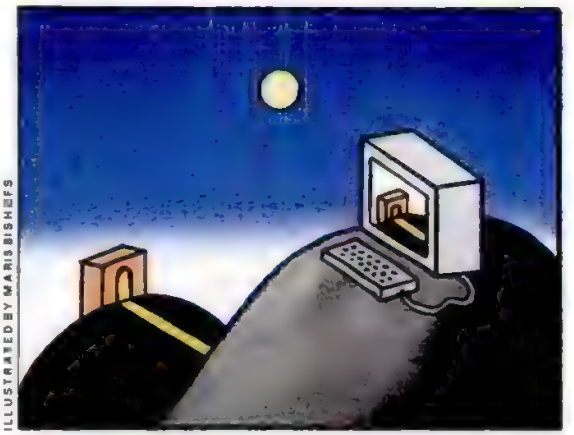
Number two, the new operating system. This is just too obvious. We have two choices: OS/2 and Windows. Furthermore, there are indications that Microsoft will just give up on DOS. You have to change or die! So we have a new operating system, just like when MS-DOS ousted CP/M.

Onward to item three: the change from 8-bit to quasi-16-bit computing. Since the advent of the 386, we've shifted to quasi-32-bit computing. The 386SX is now the low-end standard, just as the 8088 was the low-end standard of its time. The 8088 was a 16-bit processor using 8-bit memory; the 386SX is a 32-bit processor using 16-bit memory. Good parallel.

Quatre: bigger address space. In the early eighties we went from 64K to 640K. Now we're up to *terabytes* of memory. The 386 and 486 can address 4 gigabytes of physical memory and 64 terabytes of virtual memory.

Finally, and don't kid yourself, IBM is very serious about renewing its influence in the desktop arena. OS/2 is no longer a mistimed kludge of an idea, memory is now dirt cheap, and IBM is going into salesman mode.

All the parallels point toward OS/2 and IBM. We'll know for sure in the next six months or, uh, two years! For the parallel history to work, that's how long we'll have to wait. □



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CIRCLE 157 ON READER SERVICE CARD

John C. Dvorak

Inside Track

Unix Whether We Like It or Not Dept.: As many of you know, Windows NT will be so Unix-like that some people are saying that it *is* Unix. Now we hear that IBM is planning on adding "a range of Unix-like features into the next major version of OS/2, including multiprocessing, portability, and X Windows–style distributed processing." Why is this? **OS/2 should supplant Unix,** shouldn't it?

According to a *PC Week* news item, "IBM has rights to Microsoft's NT kernel, but sources said the company is focusing most of its work on the Mach 3.0 kernel, a forthcoming upgrade of the operating system kernel widely used in the Unix world."

According to the Joint Operating Agreement between IBM and Microsoft, IBM is funding the development of Windows NT. It may really be a red herring to sidetrack IBM.

There's more to this story than meets the eye. Microsoft is looking at Mach 3.0—a Unix clone—and using the ideas found there to develop Windows NT. Obviously, if IBM is going to use NT, then it's going to use Mach, too! Anyway, I found the comment to be confusing.

As for Microsoft **giving NT code to IBM**, it isn't doing IBM any favors. In fact, Microsoft must allow IBM access to NT technology because, according to people who've seen the Joint Operating Agreement between IBM and Microsoft, and **as incredible as it may seem**, IBM is funding the NT development at Microsoft! This is the great untold story in computerdom.

What's **interesting** is the possibility that Windows NT development is a red herring used to **sidetrack IBM,** which seems to be counting on using the code too. It could be the same **suckers' game** Microsoft played with IBM the first time around during the initial OS/2 debacle.

Note two things: David Cutler from DEC was hired by Microsoft to do the portable OS/2 (or what became OS/2 3.0 and what was called RISC OS at Microsoft). Cutler is largely responsible for VMS. As far as I can tell, his name isn't mentioned much in connection with NT. Item two: Microsoft is now **doing a deal with DEC** for something or other. They say it's not for Windows, but for Excel and other apps to run on the new DEC machines.

After having its top software guru stolen, why would DEC even talk to Microsoft? **Here's my theory**. Some time ago DEC blithered something about rolling VMS into the micro domain. Is it possible that Cutler was part of **a long-term scheme dreamed up by Microsoft and DEC behind IBM's back?** Cutler would go to Redmond to organize the team to develop a new operating system modeled after his VMS, not modeled after Unix or Mach! In the meantime, Microsoft would use IBM money to develop NT and other **nonsense** such as Win32 and WinLite. It would pass some Mach code back to IBM and use any good stuff in the VMS-type product. The final product would be a Windows interface on top of a portable/RISC VMS.

Hey, it's a theory. Think about it.

Heat problems, moi? Put your finger on a powered-up 50-MHz 486 and see what happens. **It's hot**. Apparently the DX2 version of the 486 is even hotter. *So* hot that the 66-MHz version of the chip will contribute to **global warming**. The manufacturers are aware of the heat problem, but users aren't. Many report **unusual crashes** when running processor-intensive Windows and OS/2.

There's **a quick fix.** From Norm Bailey comes the CPU Kooler. This is a $39.95 package consisting of a milspec fan hooked to a **heat sink,** which is glued onto the top of the 486 chip with a special thermal compound that transfers all of the heat to the heat-sink fan. Call PCubid Computer Technology in Sacramento at 916-338-1338. **They're cool guys!**

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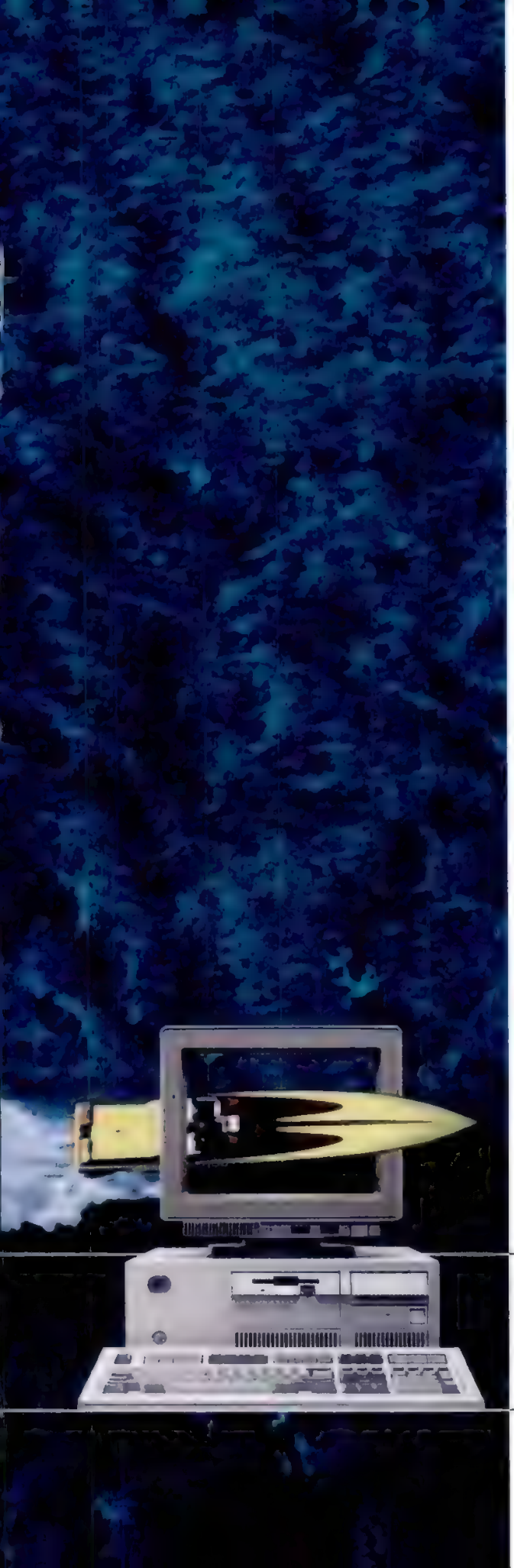

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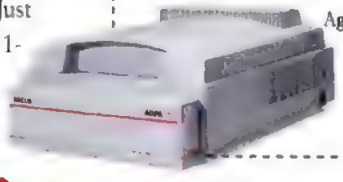

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CIRCLE 071 ON READER SERVICE CARD

Jim Seymour

New Interface Dilemmas

Last time we looked at some of the artifacts that remain in the Windows interface, and at how Microsoft's interface-design changes are catching up with our growing understanding of how GUIs can and should work.

Cleaning up such interface-convention problems as illogical keyboard shortcuts (such as Shift-Ins for Paste) in Win 3.1 was a big step. But many of Windows' problems aren't amenable to simple fixes.

The problem is that we don't yet know enough about GUIs. This is a new field; we're still figuring things out.

A favorite example is the floating (or tear-off) menu. When most PC users first see someone rip a menu from the header bar across the top of a window, then float it somewhere else on-screen, they go bananas.

I know the feeling: I fell hard for the idea myself. Being able to stash the Tools-selection menu palette in PageMaker next to the page rather than having it stuck in the right-hand corner of the display was wonderful; I shed all that mousing up and back.

But as whizzy as that idea first seemed, time and experience showed us that it isn't as hot a feature as we thought.

A floating menu still leaves us with the job of choosing from among all those commands—not all of which are even relevant to our work. Why isn't the computer smart enough to choose only the commands we want, and show us just those?

Worse, the choices on that menu rarely represent the whole universe of commands we might need to accomplish our work. So we still have to make those long mouse roundtrips to the menu bar for those items that are buried under other menu headings. Why can't the computer show us—in a combined menu palette right next to the selected object—*all* of the commands we need?

Enter the property inspector.

As good as floating menus looked, the newer property inspector idea is even better. Just select something in your document, spreadsheet, drawing program, or whatever, then click on the right mouse button. An ad hoc menu pops up next to the item you've selected, with access to everything you need to manipulate that item's properties.

Borland started the property inspector idea, first seen in ObjectVision 2.0 last year and coming in this year's Quattro Pro/Windows and Paradox/Windows. Microsoft agrees that this is a good idea, but questions what we want in such a menu.

Borland hewed to the classical "manipulate an object's properties" approach; Microsoft showed in Excel 4.0 that localized pop ups need verbs, too. That is, pop-up menus should list things you can do with an object—such as cut, copy, and paste—not just things that address the object's properties, such as font and color.

Expect to see property inspectors in new releases of many programs. It'll be interesting to see whose approach prevails. I'm betting on Microsoft's more comprehensive answer. Windows itself will probably gain verb-inclusive property managers in Version 4.0, due next year.

If part of the puzzle in designing better GUIs is discovering new possibilities, another is managing the transition to newer ways of working with those interfaces.

ILLUSTRATION BY MARK S. BISHOFS

Why isn't software smart enough to show us only the menus we need?

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CIRCLE 089 ON READER SERVICE CARD

Jim Seymour

This task is often neither simple nor obvious.

Implementing drag-and-drop is a perfect example: You might click on an icon representing a file, drag it over an icon representing a printer, and drop it there; the document is then printed.

That's much faster and easier than loading the program, then loading the file, then choosing Alt-F, P, or using the mouse to issue the print command. Of course, if you already have the document on-screen, within the program, the Alt-F, P sequence is much faster.

When you're at the Windows desktop level, however, and you want to drag-and-drop print the file, what should the keyboard shortcut—the interface convention—be?

It's easy to drag and drop when you're using a mouse. But many Windows users would rather use keyboard shortcuts to complete many tasks. It would be intolerable to have an important Windows function that you could not execute from the keyboard. Yet there is no logical keystroke equivalent to that action, *because it is a new way of working*. Interface conventions are based on our old ways of working.

Finally, continuity counts in interface design. I used to mutter about Microsoft's shortsightedness every time I had to remember whether to use Shift-Del or Ctrl-Ins to cut something. In Win 3.1, that problem's been cleaned up, and we have the more consistent Ctrl-X for cutting, Ctrl-C for copying, and Ctrl-V for pasting.

But what about older applications, such as PageMaker 4.0? Subsequent releases of these programs will explicitly support the new keyboard shortcuts, but because the programs work within the Windows environment, you can already use the new conventions with them. No more Shift-Ins for pasting; Ctrl-V does the trick—even if that doesn't appear on PageMaker's menus.

The evolution of interface conventions is not a pretty sight. We'll see lots more shifts before we get it right—and with any luck, by then we'll be using voice input instead of mice and keyboards. □

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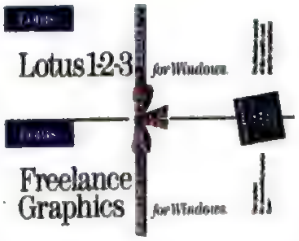

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CIRCLE 221 ON READER SERVICE CARD

William F. Zachmann

Deciphering 32-Bit Technospeak

Who needs a "32-bit, truly preemptive multitasking, multithreaded operating system with virtual memory management and support for virtual DOS machines"? What does all that stuff do for us?

Plenty! Those technical features translate into very specific benefits for users. Let's examine each one. A *32-bit* processor, such as an Intel 80386 or 80486, has more address space, a wider physical bus, and larger instruction operand and register sizes than a 16-bit processor like the 8088, 8086, or 80286.

Of these features, a 32-bit processor's most important benefit comes from the processor's larger address space—up to 4GB, compared with a 16-bit processor's 16MB limit. But you need a 32-bit operating system, such as OS/2 2.0 or Microsoft's not-yet-released Windows NT, to reap this benefit. Software written for DOS or for the Intel 8088/8086's or 80286's segmented architecture must manage data and programs in 64K segments. That requires a lot of overhead. A true 32-bit operating system's large memory address space eliminates that overhead, so programs are more efficient and run faster.

Truly preemptive multitasking means not only can many apps run at once, but programs that perform time-critical tasks can get control of the processor when they need it. This allows terminal emulation, LAN connectivity and asynchronous communications programs to run more reliably.

Windows 3.0 and 3.1 provide *cooperative,* not preemptive, multitasking. Once the programs get control of the processor, the OS cannot intervene when another task requires the processor.

OS/2 2.0 provides preemptive multitasking, as will NT. When the processor receives an interrupt from a LAN adapter or a modem, for example, the OS can preempt the program presently running to give the comm software control.

Multithreaded means each program can create many subprograms and run them simultaneously. A word processing program might spell-check one document while we work on another one, for example. Multimedia apps, in particular, will benefit enormously from the use of multiple threads by helping synchronize sound, video, and animation.

Virtual memory management lets programs use far more memory than the system has, by paging out memory to disk. DOS 5.0 and Windows 3.1 provide limited virtual memory management. But combined with the capabilities discussed above, this feature becomes much more reliable and powerful.

With OS/2 2.0, for example, we can do a DISKCOPY while we continue our work reliably. OS/2 2.0 uses virtual memory management to copy the entire contents of the floppy disk into memory, so we insert the source and target disks once.

Support for virtual DOS machines (VDMs) lets OS/2 2.0 run DOS and Windows apps reliably, and lets us tailor each virtual machine to the configuration that best supports those apps. Though Windows 3.1 lacks VDM support, NT promises this capability.

All those phrases may sound like *technospeak,* but they provide tangible benefits. That's why we're likely to move quickly to newer operating systems such as OS/2 2.0 or NT. Even DOS is likely to try to incorporate such facilities—if it can. □

ILLUSTRATION BY MARSHALL SHORE

How can you reap the benefits of a 32-bit operating system if you can't speak the language?

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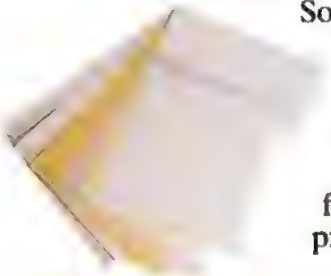

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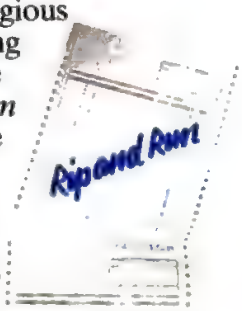

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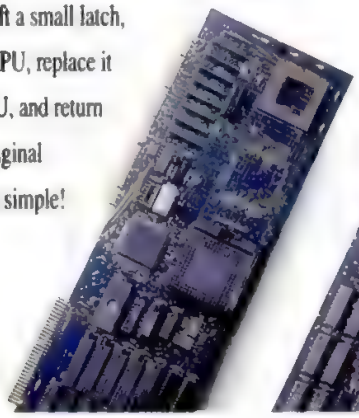
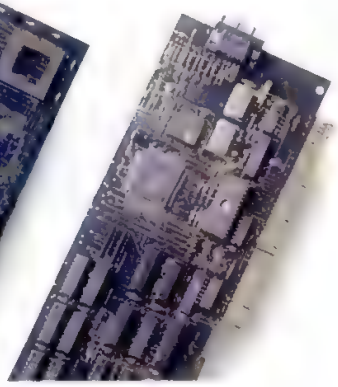


• *Upgradable CPU Module*



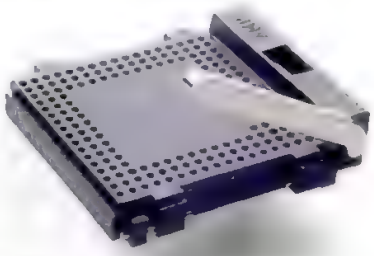
• *32-Bit EISA Local Bus SVGA Card*

COMPATIBILITY :

Our system boards have been tested and certified to be 100% compatible with all EISA and ISA based add-on cards as well as with all major software packages.

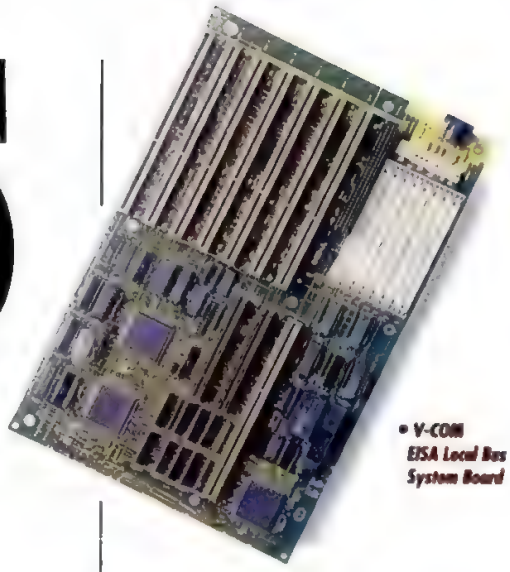
COMPETITIVE PRICE :

Our goal at V-COM is to make this revolutionary new technology available to everyone. This means offering it at the most competitive price possible.



• *EZ Switch CPU Socket*

CAL BUS
the First Time Ever!



• V-COM EISA Local Bus System Board

V-COM 486/33ES $2697

- 80486DX-33 Processor
- V-COM EISA LOCAL BUS main board
- Full Tower Case w/ Digital Display

V-COM 486/33E $2297

- 80486DX-33 Processor
- V-COM EISA LOCAL BUS main board
- Desk Top Case w/ Digital Display

V-COM 486DX2/50ES $2897

- 80486DX2-50 Processor
- V-COM EISA LOCAL BUS main board
- Full tower Case w/ Digital Display
- Math Coprocessor
- 256K Cache RAM expandable to 512K
- 8MB RAM (expandable to 128MB on-board)
- 1.2 MB 5.25" Floppy Drive
- 1.44 MB 3.5" Floppy Drive
- 200 MB Hard Drive
- Two EISA LOCAL BUS expansion slots
- 2 Serial / 1Parallel / 1Game port
- V-COM High speed SVGA card, Resolution up to 1280 x 1024 & up to 32,768 colors
- V-COM 14" Color Non-Interlaced Low radiation monitor
- V-COM 142 Key progammable keyboard
- High-resolution mouse
- Microsoft Windows 3.1 & DOS 5.0

V-COM 486DX2/50E $2497

- 80486DX2 Processor
- V-COM EISA LOCAL BUS main board
- Desk Top Case w/ Digital Display
- Math Coprocessor
- 256K Cache RAM expandable to 512K
- 4MB RAM (expandable to 128MB on-board)
- 1.2 MB 5.25" Floppy Drive
- 1.44 MB 3.5" Floppy Drive
- 120 MB Hard Drive
- Two EISA LOCAL BUS expansion slots
- 2 Serial / 1Parallel / 1Game port
- V-COM High speed SVGA card, Resolution up to 1280 x 1024 & up to 32,768 colors
- V-COM 14" Color Non-Interlaced Low radiation monitor
- V-COM 142 Key progammable keyboard
- High-resolution mouse
- Microsoft Windows 3.1 & DOS 5.0

Get the options you desire at one low price!
Just look at what our systems include

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V-COM 15" FLAT SCREEN MULTI SCAN MONITOR $147

V-COM EISA/IDE CACHING CONTROLLER $397

- 1MB Cache RAM expandable to 24MB
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- Supports EISA drivers for Novell, SCO Unix, Interactive Unix and AT & T Unix.
- Cache access time less than 0.3ms.
- Supports 4 IDE drives with up to 4 Gbytes per drive.
- Supports 2 floppy drives.
- Transfer rate from EISA bus to cache up to 16.5 Mbytes/sec.
- Transfer rate from cache to disk up to 16.5 Mbytes/sec.

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CIRCLE 090 ON READER SERVICE CARD

The Perfect

Which components make the best PC? The fastest? The most affordable? PC Magazine Labs tests CPUs, hard disks, video adapters, and peripherals to help you configure your next PC the way you want it.

by Winn L. Rosch

Whether you buy your next PC off the shelf, have one custom-built, or build your own, you want to get the best buy—the machine and components best suited to you and your budget. You want the fastest machine with the most storage and the sharpest video, you want it affordable, and you want it *now*.

In this issue, we'll help you build—or more likely, configure—the perfect PC. We will examine the four most important functional parts of a PC in four sections:

- the system unit (the processor, CPU cache, RAM, motherboard, case, and power supply);
- mass storage (the hard disk and floppy disk drives);
- the display subsystem (video adapter);
- peripherals (the monitor, keyboard, and modem).

Most good PC dealers and vendors, especially the direct marketers, give you substantial leeway in specifying components. You can order your system with a 200MB, 300MB, or 400MB IDE, SCSI, or ESDI hard disk (with or without on-board caching). But which one performs best? To get definitive answers, we charged PC Magazine Labs with sorting which technologies best benefit your PC—the quickest microprocessor, the

No-Holds-Barred PC

We've configured three perfect PCs: no-holds-barred, Windows workstation, and a budget PC. Our no-holds-barred PC (right) comes in a tower case with a 486/50 CPU, eight expansion slots, two floppy disk drives, SCSI connections (to link the hard disks, CD-ROM drive, and tape drive), and a generous 300-watt power supply. For a network server, a 14-inch VGA monitor can suffice.

MONITOR
A 14-inch VGA color monitor is fine for a file server, but graphic powerhouses need 1,024-by-768 resolution and a 16- to 19-inch screen.

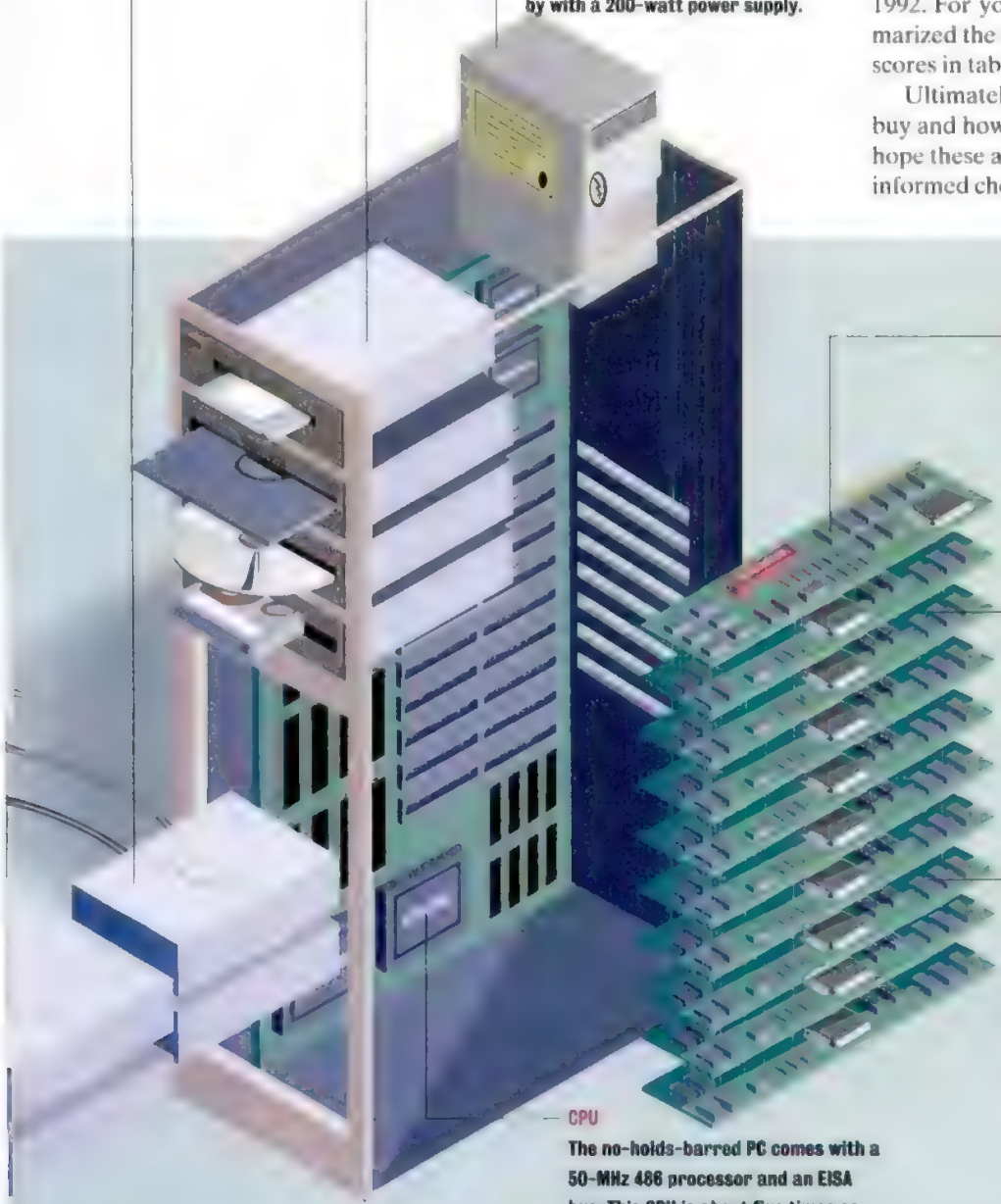
KEYBOARD
Almost all standard keyboards have 101 keys. The feel is subjective: Compaq-style keyboards have a soft touch; IBM's style is clicky.

PC

best hard disk interface, the most responsive video. The results may surprise you: For example, megahertz don't always matter most, and hard disk interfaces have little effect on performance.

When you buy a PC, you also want to know how a specific brand and model performs and how reliable it is. For hands-on comparative reviews of complete PC systems, you will want to read the regular PC reviews appearing in virtually every issue of *PC Magazine*. For service and reliability ratings of 35 major brands, see "Service and Reliability 1992: How Reliable Is Your PC Vendor?" *PC Magazine*, May 26, 1992. For your convenience, we've summarized the service and reliability ratings scores in table format in this issue.

Ultimately, the decision of what PC to buy and how to equip it lies with you. We hope these articles help you make a more informed choice.



STORAGE MEDIA
Look for at least four front-accessible half-height drive bays and room for at least four more drives inside the case. We stocked our system with both 1.2MB and 1.44MB high-density floppy disk drives, a CD-ROM drive, and a tape backup unit. Two or more hard disks allow fault-tolerant operation.

POWER SUPPLY
Even a power-hungry system with many large storage devices can get by with a 200-watt power supply.

VIDEO ADAPTER
A VGA card may suit a file server, but if your ultimate system runs Windows, an accelerated VGA card can boost performance to 3 to 20 times that of a dumb frame buffer.

MODEM
For heavy communications, nothing less than a 9,600-bps (V.32) or 14,400-bps (V.32bis) modem will do. Look for a modem with V.42bis data compression and V.42 error control.

SCSI CONTROLLERS
A SCSI controller attached to two hard disks, a CD-ROM drive, and a tape backup unit can be useful on a system with a need for many storage devices. For the fewest installation problems, install all the components at the same time.

CPU
The no-holds-barred PC comes with a 50-MHz 486 processor and an EISA bus. This CPU is about five times as powerful as a 20-MHz 386SX.

The System Unit

Motherboards, Cases, and Power Supplies Provide the Foundation

Electrically, logically, and mechanically, the foundation of any PC is its system unit. Essentially a minimal computer, the system unit amounts to the smallest collection of parts that can process information: a motherboard, a case, and a power supply.

The motherboard is your central concern when buying or building a PC. Its microprocessor, or CPU (central processing unit), determines the performance and software compatibility of the entire PC. Today, a 486 will deliver the best performance, but a 386 can be a better value. Anything less will be inadequate. Memory varies both in quantity and performance, and, as with the microprocessor, memory affects how much you can do with your PC. The right memory architecture can make one PC outperform others with the same CPU running at the same speed, but the right quantity of memory often makes the difference in how much work you can get done.

A third part of the motherboard—the I/O bus—has been the subject of controversy over the past two years. Should you stay with the classic 16-bit ISA bus, or are there benefits to moving up to an advanced 32-bit bus (EISA or MCA) when you move to a more powerful processor? Or should you avoid the bus question altogether and wait for local-bus technology to mature?

Buying a system that can grow with your needs means choosing one with enough expansion slots and drive bays—and enough juice to run the peripherals you connect. The best PC for you will combine your choice of microprocessor, memory, BIOS, bus, case, and power. Here's a closer look at each.

THE MOTHERBOARD

Although you will see hundreds of brands of computers, you may find only a few dozen motherboard makers. Many second- and third-tier system vendors (just about any company other than IBM, Compaq, and a handful of others) source their motherboards from vendors such as Advanced Integration Research (AIR), American Megatrends (AMI), ATI Technologies, Dash Computer, Micronics Computers, Mylex Corp., and Technology Power Enterprise, to name a few.

The motherboard consists of 6 to 12 layers of conductive copper circuit traces glued together. It holds all of the electrical components necessary to bring a computer to life, including the microprocessor, memory, chip set, BIOS, and bus. The more layers the better. Some of those layers serve as ground planes that isolate the radiation (meaning electromagnetic energy or radio frequencies) from other layers, and this makes the board more resistant to noise.

Many motherboards are made from textbook designs (provided by the chip set makers), with only the layout of the parts exposing the engineering artistry of the board maker.

Two qualities distinguish motherboard layouts: *access* and *radiation*. A good layout allows you to access sockets for upgrades without removing the motherboard from its case. The microprocessor, coprocessor, upgrade, and memory sockets should never be located where a power supply, drive bay, or expansion board blocks access.

The layout also affects how much radiation the motherboard emits: Better layouts give off less radiation. Since every wire becomes a more efficient radiator as the motherboard's clock frequency increases, the higher the frequency, the more critical the layout becomes. Consequently, designing high-frequency motherboards is a more expensive endeavor. Although some motherboards are built to handle a range of CPU speeds within a category (say, from 25 Hz to 50 MHz for a 486 motherboard), simply changing the clock crystal and the microprocessor on a typical motherboard will not necessarily make a PC faster.

Lower-frequency operation is the incentive for manufacturers using Intel's clock-doubling 80486DX2 chips. These chips provide internal microprocessor operations at twice the clock speed of the motherboard, cutting both motherboard radiation potential and design costs compared with 50-MHz 486DX motherboards.

The motherboard's *size* determines how large a case you need. In a better system, only a small portion of the motherboard should be hidden under the drive bays. Two motherboard sizes have emerged as standards: XT (8.5 by 12 inches) and AT (12 by 13.5 inches). While XT-size boards fit nearly all cases, you will need a full-size AT case for an AT-size motherboard.

CPU CHOICE

Exactly what work your PC can do—which applications it can run and how quickly it can run them—depends on the microprocessor. Although Intel has intro-

Windows Workstation

For the ultimate Windows performance, choose a system with a 1,024-by-768 resolution. An accelerated video card or local-bus video implementation is a must, as is a 17- or 19-inch monitor for viewing the high-resolution image. A 486/33 CPU provides nearly double a 386SX/20's Windows performance. Also featured: a 200MB IDE hard disk, two floppy disk drives, a CD-ROM drive, and a 150- to 200-watt power supply.

MONITOR

Viewing graphics and text comfortably in advanced graphics modes requires a larger screen. We suggest a 19-inch color monitor for 1,024-by-768 or a 17-inch monitor for Super VGA.

duced nearly two dozen individual chips with different speeds and discrete performance levels, the ones you should consider are based on Intel's 386/486 architecture. The 8088 and 80286 CPUs lack the features demanded by today's applications, operating systems, and environments.

The 386 family provides several features that the earlier chips lacked, such as 32-bit processing, the direct addressing of up to four gigabytes of memory (compared with the 286's 16MB), internal memory management (which allows the 386 to remap physical and logical memory), and a special operating mode that allows the chip to run several DOS applications at once. The 486 series of microprocessors is for the most part an improved version of the 386 series, with two key additions built into the chip's single slice of silicon: an 8K cache and a floating-point unit (or FPU, also known simply as a math coprocessor). Intel's engineers also redesigned the logic circuitry of the 486 chip so that it can carry out more calculations in fewer clock cycles.

Five chip types in the 386 and 486 families deserve consideration for desktop use. In the order that Intel introduced them, these are the 80386DX, the 80386SX, the 80486DX, the 80486SX, and the 80486DX2.

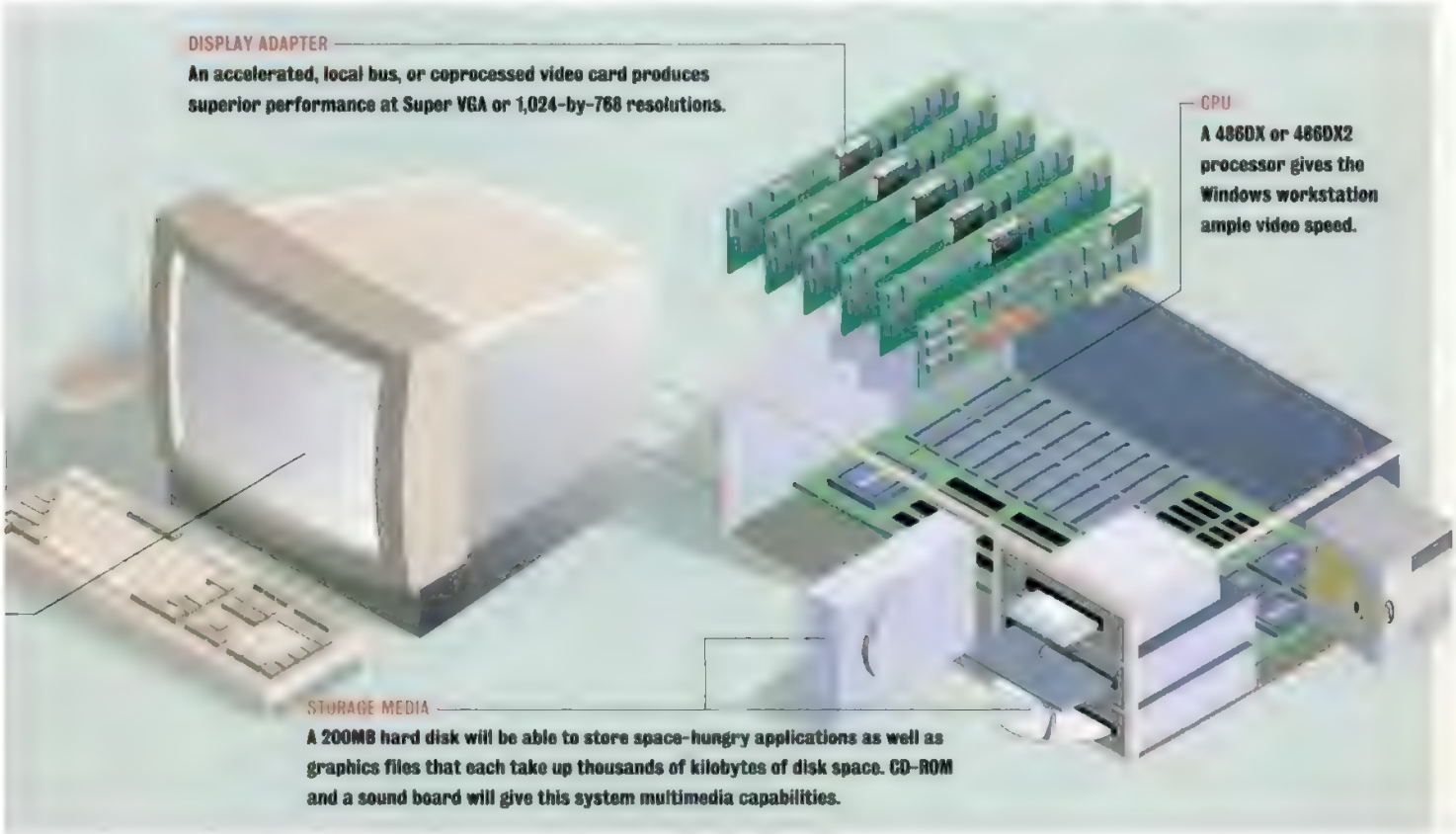
A 486/33 turns in processor performance about 85 percent better than and memory performance more than double that of a 386/33 on PC Labs' benchmark tests.

■ The 80386DX delivers full 32-bit data handling. It processes instructions and delivers data 32 bits at a time and is most commonly available in clock speeds of 25 MHz and 33 MHz.

■ The 80386SX is the low-cost, low-performance member of this family, available in 16-, 20-, and 25-MHz flavors. It features an internal bus with a 32-bit data path, but it has a 16-bit external data bus. Using the latter helps to trim the cost of the system board's support circuitry.

■ The 80486DX's improved design gives 486s significant improvements in processor and memory performance. A 486/33 turns in processor performance about 85 percent better than and memory performance more than double that of a 386/33 on standard PC Magazine Labs benchmark tests. The 486DX's internal math coprocessor dramatically improves performance on software that uses it: statistical analysis, CAD, and vector graphics packages, for example. On the other hand, the coprocessor shows few benefits on the basic spreadsheet functions that most business users need (any function related to addition, subtraction, or division). When PC Labs last checked coprocessor performance, we found that the 486's internal math coprocessor handled floating-point calculations twice as fast as the combination of a 386DX and 387DX FPU operating at the same clock speed (reported in *PC Magazine*'s "Math Coprocessors: Fact or Fantasy," February 12, 1991, page 301).

■ Intel released the 80486SX (essentially a 486DX without the FPU) for customers who have no need for a



coprocessor. The 486SX serves as a more efficient 386DX and has the upgrade potential that Intel recently built into much of its 486 line. Available in 16-, 20-, and 25-MHz varieties, the 486SX is designed to process instructions almost twice as quickly as 386s running at the same clock speed. In fact, a 486SX/25 motherboard outperforms a 386DX/33 CPU on PC Labs' benchmark tests by 40 percent.

■ The 80486DX2 is a 486DX that runs internally at twice the speed of the clock signal applied to it, but externally at the same speed as that signal. A 50-MHz 486DX2, for example, uses a 25-MHz clock crystal, and runs internally at 50 MHz but externally at 25 MHz. This technology allows for the use of lower-frequency system board components to make less expensive systems. PC Labs' tests show that the 50-MHz 486DX2 chip meets the processor performance of its 50-MHz 486DX counterpart. Although our tests also show that the 486DX/50's memory performance is only about 3 percent better than that of the DX2/50, the 486DX2/50's 25-MHz external speed may cause memory performance to be somewhat slower in applications that reach beyond the chip's internal cache—principally multitasking operating systems.

A few other chip models are available for specialized applications. The 80386SL is a low-power version of the 386SX designed for notebook computers, and Intel will release a low-power 80486SL (3.3 volt) later this year. The 386SLC is a proprietary IBM improvement on the 386SX, souped up with a streamlined processor design and an internal cache borrowed from the 486. Later this year, IBM plans to introduce its own improvement on the 486SX, as well: the 486SLC.

Intel-compatible CPUs are already on the market; most notable are the 40-MHz 386DXs (including a 3.3-volt version for laptops), 33-MHz 386SXs, and 25-MHz 386SXs from Advanced Micro Devices (AMD). Chips & Technologies and Cyrix also have plans to enter this market. Cyrix has also announced a 486-compatible chip, and AMD will soon follow.

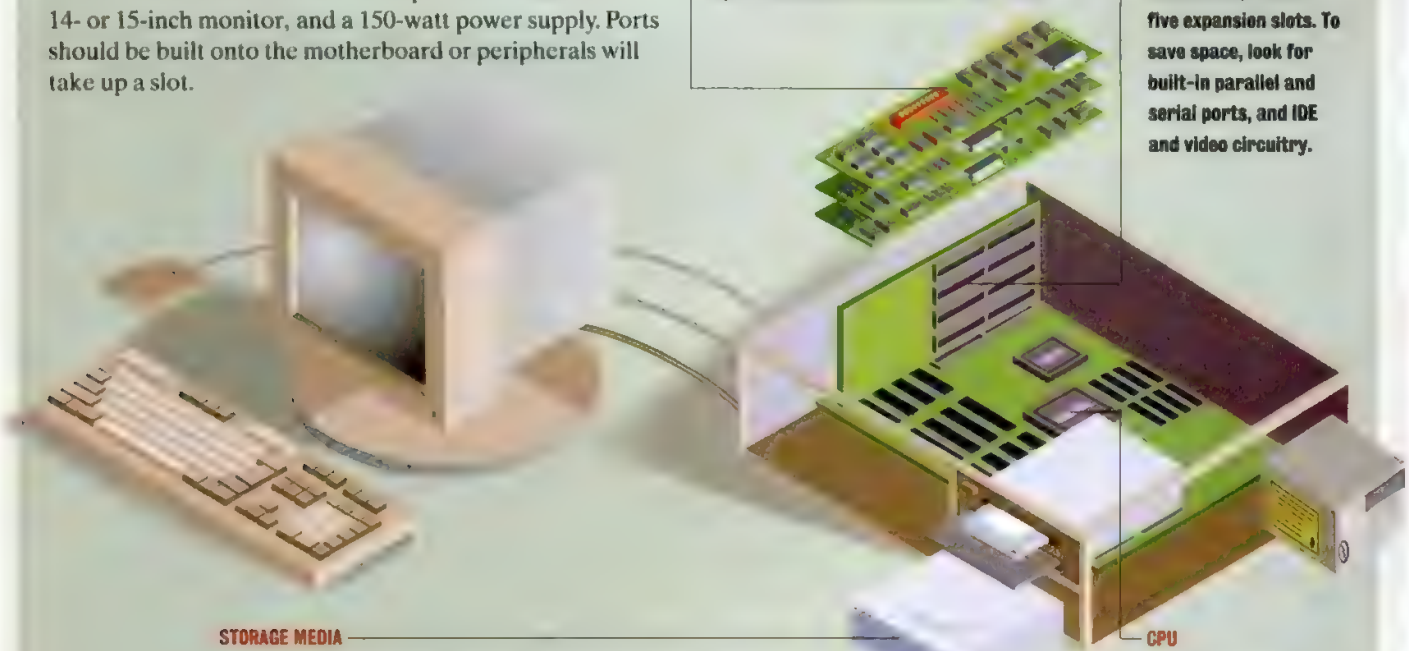
CPU PERFORMANCE

To put the performance relationship of today's top microprocessors in perspective, PC Labs tested nine motherboards using different CPUs. We chose one popular source, AMI, and requested seven ISA and two EISA boards: 486DX2/50, 486DX/33, 486SX/25, Am386-40 (using an Advanced Micro Devices CPU), 386DX/33, 386SX/25, and 386SX/20 ISA motherboards; 486DX/50 and 486DX/33 EISA boards. We ran PC Magazine Labs' Hardware Performance Tests, Version 6.0, and compared the results with the performance of an original IBM PC (a 4.77-MHz 8088) and an IBM AT (an 8-MHz 80286).

Performance varies dramatically from

The Budget PC

A 386SX/20 PC in a small-footprint case provides the entry-level user with a reasonably priced, practical business system, though Windows may seem a bit slow. Look for a 100MB IDE hard disk, VGA or Super VGA resolution, a 14- or 15-inch monitor, and a 150-watt power supply. Ports should be built onto the motherboard or peripherals will take up a slot.



DISPLAY ADAPTER
On a 14- or 15-inch display, Super VGA is minimally readable and most users find 1,024-by-768-resolution characters too small.

EXPANSION SLOTS
Small-footprint and low-profile cases may contain only four or five expansion slots. To save space, look for built-in parallel and serial ports, and IDE and video circuitry.

STORAGE MEDIA
The entry-level PC should come with an IDE hard disk with at least 100MB of storage, and both 1.2MB and 1.44MB high-density floppy disk drives. You can find high-capacity hard disks in a 3.5-inch form factor.

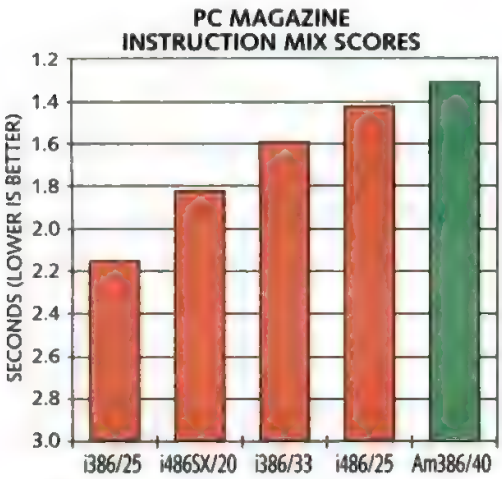
CPU
A 20-MHz 386SX is the minimum choice for today's DOS applications.

FASTMICRO REVEALS THE SECRET BEHIND THE FASTEST 386 EVER!

IT'S THE AMD 386 PROCESSOR!

Want the fastest 386?

Why settle for anything slower, the 40 mhz Am386DXL from Advanced Micro Devices is the fastest 386 chip on the market, hands down. Not only does it outperform all other 386 chips, it even outperforms many 486 processors too. When looking for a 386 or 486 PC, look for the Am386DXL-40; it's over 20% faster than 33mhz 386 processors, over 31% faster than the Cx486SLC-25, over 50% faster than the i486SX-20, and over 13% faster than the i486SX-25 (in MIPS as tested by Power Meter vers. 1.5). The data speaks for itself - don't *pay more* and *get less.*



According to a Jan. 14 1992 PC Magazine Review, the Am386/40 was faster than all other 386 processors, it was even faster than most available 486 processors!

Look under the hood.

The AMD processor is easy to spot. Just look for the logo to the left. It's the only way to get the fastest 386 performance at the price of an ordinary 386 PC.

More Power Per Dollar.

Not only is the Am386DXL-40 faster than the i486-25, it's a better value too! The AMD chip costs a lot less than the price of the

Compare the cost of the Am386DXL-40 against the i486SX-25 and the faster Am386 chip actually costs less! FastMicro really stretches your computing budget.

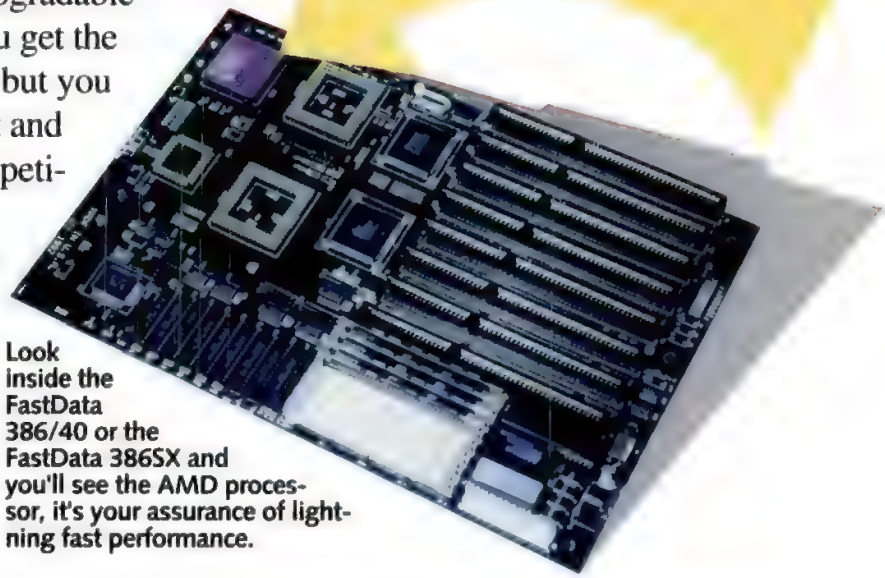
486SX and FastMicro passes the savings and performance gain on to you. Plus, there is no sacrifice in upgradablility - read on!

Certified Compatible - of Course.

The Am386 processor family is certified compatible with all 386 compatible hardware and software. It has flawlessly passed tests from every top computer publication and has been tested in over 100 different 386 systems (including FastMicro's) and passed all tests without a single failure or incompatibility. Its compatibility has even been certified by XXCAL Testing Labs.

Buy Today - Upgrade Tomorrow.

The FastData 386-40 is the most upgradable PC on the market! Not only do you get the most power for your money today, but you can upgrade your system to current and future 486 processors. Unlike competitors' very expensive proprietary upgrade cards, all you do is plug in a new processor & a $20 clock crystal (the silver part at the top center of the board) and change some jumper settings. Processors & crystals are widely available. You can install i486DX, i486DX/2, i486SX, announced AMD 486 CPUs & even promised next generation i586 upgrade processors, all up to 50mhz external clock rate (100mhz for DX/2s and other doubler designs). That's more flexibility than other companies' 486 computers. FastMicro really maximizes value today and protects your investment tomorrow!



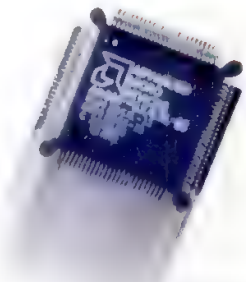
Look inside the FastData 386/40 or the FastData 386SX and you'll see the AMD processor, it's your assurance of lightning fast performance.

BUYER'S CHECKLIST

	FastData 386/40	Other 386's	Other 486SX's
386 Priced	X	X	
40mhz Performance	X		
486SX Overdrive Ugr.	X		X
486DX Upgradeable	X		
486DX2 Upgradeable	X		
Cache Upgradeable	X		?
170mb Conner Drive	X		
7 Drive Bays	X		
Dual Cooling Fans	X		
GE On-Site Service	X		
7th Year in Business	X	?	?

The Fastest 386SX Too!

The latest high performance 386 processor from Advanced Micro Devices is the Am386SXL-33. It's 32% faster than 25mhz 386SXs and combined with FastMicro's 16K optimized cache, it boosts performance to 74% above normal 386SX-25 levels.



FastMicro's got the new Am386SXL/33

FastMicro includes the fastest 386 chips.

Don't settle for less, FastMicro's new 386/40, 386SX/25 & 386SX/33 utilize high performance 386 processors and do it at a price that will make ordinary 386 PCs obsolete. Plus FastMicro backs every PC with its award-winning support and service. Turn the page to learn more!

FASTMICRO PRESENTS THE FASTEST 386 PC'S

FastData 386/40

$1499

INCLUDES

- Am386DXL™ 40mhz Processor
- 64K Static RAM Cache
- **Upgradable to 486 Processors.**
- 4 megabytes of high speed RAM.
- **170 mb 17ms IDE hard disk, 1:1 interleave with 32K cache.**
- 1.2mb 5.25" & 1.44mb 3.5" drives.
- New Generation Desktop Case.
- 72hz Non-Interlaced 14" Super VGA color monitor, 1024x768 resolution.
- **16 bit SVGA card with 1mb Ram, 32,768 Colors & Windows Accelerator.**
- Clock calendar, parallel port, game port and two serial ports.
- 8 expansion slots, 2 occupied.
- Microsoft Windows 3.1 & Mouse.
- MS-DOS 5.0.
- FastMicro Peace of Mind.

Microsoft WINDOWS *Included Free!*

A System That's Cool & Quiet? FastMicro Innovates.

Every new desktop FastData PC comes with dual cooling fans. It has a main fan that's quieter than fans in ordinary PCs- plus, it includes a special second fan that comes on only when the system gets warm. A cooler system lasts much longer - a concern particularly when upgrading to higher heat-producing clock doubler chips.

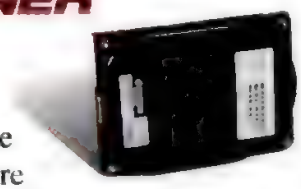
Fourth Generation Case

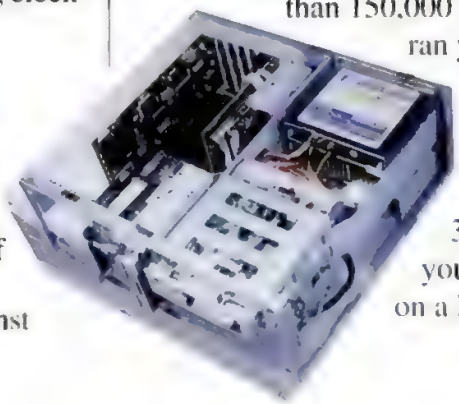
Our new desktop case has been developed to afford maximum strength, expandability and protection in a versatile and compact design. From the minute you look inside, you know this is not like the minimum cost cases most of our competitors use. It includes no less than seven drive bays and has extra protection against radio interference.

Powerful 170 Mb IDE Drive.

FastMicro includes Conner's CP-30174 170mb IDE hard drive standard in the FastData 386/40. Conner has a reputation for building the most reliable drives on the market, in fact, the CP-30174 has a MTBF (mean time between failures) rating of more than 150,000 operating hours. If you ran your FastData system 24 hours a day - that's more than *17 years*! Couple this with a <17 millisecond access time and 32K built-in cache and you won't want to gamble on a less reputable drive.

CONNER





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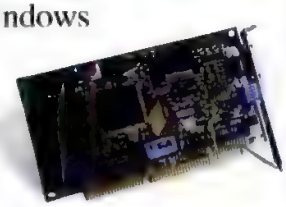

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the 8088 to the fastest 486: a 50-MHz 486 is more than 50 times as fast as the original IBM XT, with its 4.77-MHz 8088 processor. As a more practical indication, a 50-MHz 486DX is about five times as fast as a 20-MHz 386SX.

All else being equal, the performance of a microprocessor model tracks the clock speed at which it runs. Under the PC Labs benchmark tests, for example, a 33-MHz 386DX shows 33 percent better processor performance than a 25-MHz 386DX. But this clock-speed relationship does not always apply across CPU categories. Most notably, a 25-MHz 486SX outperformed a 33-MHz 386DX by 40 percent on our most recent processor test.

Memory performance, on the other hand, does not necessarily track clock speed. At high clock speeds, memory cannot keep up with the microprocessor and holds back performance. On PC Labs' DOS-based benchmark tests, for example, a 50-MHz 486DX motherboard showed about 50 percent better processor performance than a 33-MHz 486DX, but only about 25 percent better memory performance.

Microprocessor bus-width and clock-doubling technology should influence memory access speed, but PC Labs testing showed that properly designed motherboard caches can effectively be used to increase the performance of the memory subsystem.

CPUs: What's Available

Intel, AMD, and Cyrix sell more than 20 different CPUs in the 386 and 486 families. The fastest CPU currently on the market, Intel's 486/50, is more than five times as fast as a 386SX/20.

■—YES □—NO

	Clock speed (megahertz)							
Chip type	**16**	**20**	**25**	**33**	**40**	**25/50**	**33/66**	**50**
386SX	■	■	■	□	□	□	□	□
386SL	■	■	■	□	□	□	□	□
386DX	■	■	■	■	■	□	□	□
486SX	■	■	■	□	□	□	□	□
486SX, low power	■	■	■	□	□	□	□	□
486DX	□	□	■	■	□	□	□	■
486DX, low power	□	□	■	□	□	□	□	□
486DX2	□	□	□	□	□	■	TBA	□
OverDrive	□	□	□	□	TBA	TBA	TBA	□

TBA—To be announced. Intel is expected to release these chips later this year.

MEMORY MATTERS

A critical performance issue with current PCs is tuning the RAM to match the microprocessor. When a CPU needs to send data to or pull it from memory and the memory cannot supply it fast enough, the microprocessor must temporarily stop and wait for one or more cycles of the system clock for memory to catch up. Each cycle that ticks by is counted as a wait state, and each wait state cuts performance proportionally. PCs typically require two cycles for a memory access;

HIGHLIGHTS

System Unit

INTEL SELLS about two dozen different processors. Adding a cache to any of the 80386s or 80486s gives you even more choices and about 50 different speed levels. 80386s cost less, but 80486s give buyers upgrade potential.

TODAY'S FASTEST CPU, the 50-MHz 486DX, is about 50 times as fast as the original IBM PC (a 4.77-MHz 8088) and about 5 times as fast as a 20-MHz 80386SX.

PROCESSOR RAM cache (or memory cache) is a block of fast memory (typically 32K to 256K) that can boost processor and memory performance.

IF YOU ARE running current desktop applications, an ISA bus will suffice. For file server duty, however, a powerful PC will benefit from the EISA bus, which is enjoying its biggest growth, or MCA. The MCA bus is largely confined to IBM users.

LOCAL-BUS video remains a technology without a standard. The local-bus video implementation on Chips and Technologies' Wingine motherboard performed 20 percent better than a coprocessed video card and about four times as well as a vanilla VGA card.

A MOTHERBOARD with Random Access Memory capacity of 16 megabytes or more should be adequate for most of today's applications. There is no difference in performance between on-board memory and memory expansion cards. File servers should have 32MB to 64MB capacity.

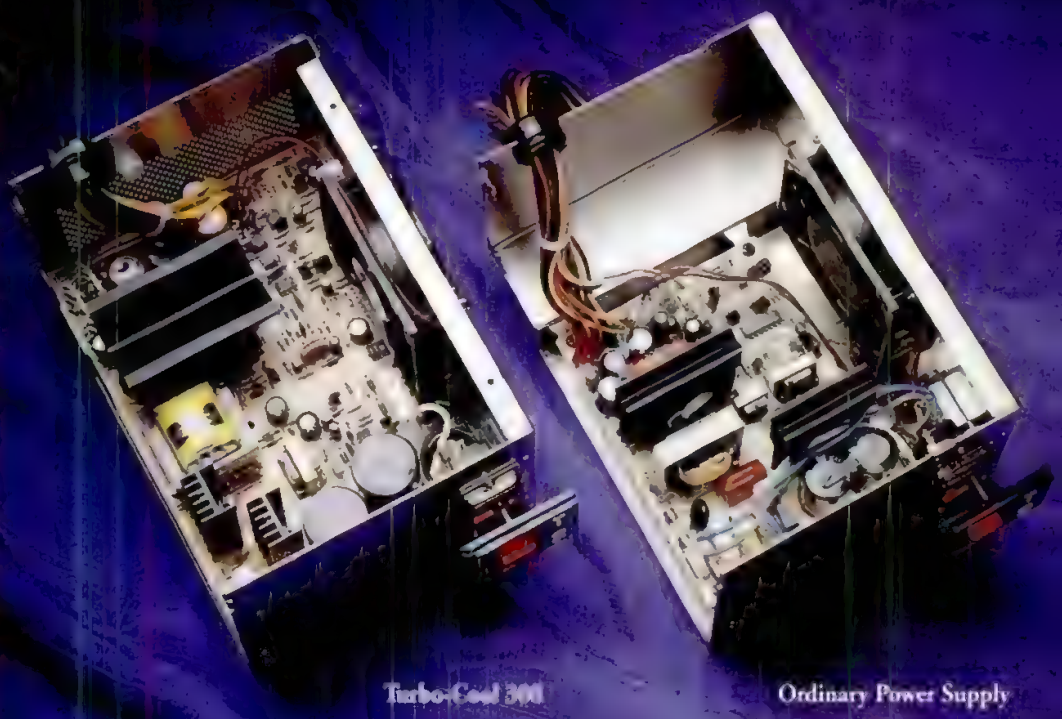
INTEL WILL let you upgrade your 80486 in one of two ways: with a 169-pin OverDrive chip that fits into a separate socket on the motherboard or with a 168-pin version of the same chip (scheduled for release later this year) that fits into the original CPU socket. Both versions are the functional equivalents of Intel's 486DX2 CPU.

YOU CAN choose from five case styles: AT-size, mini-AT, small-footprint, slimline (a small-footprint with a low height), or tower. The case determines the number of drives and the size of the motherboard you can fit inside; you should consider cases that have room for at least two floppy disk drives, a hard disk, and possibly a backup device.

A 150-WATT power supply is ample for most desktop PCs, although many use between 200 and 250 watts.

LOOK AT THE INSIDE STORY ON POWER SUPPLIES.

What power supply is inside your computer? If you are like most people, you don't know, and frankly, don't care. But, because your computer's power supply is a critical system component, what you don't know, may hurt you. An inferior power supply can cause interference, rebooting, hard drive errors, and other nasty hard-to-track problems. So why take chances? Call the power supply specialists at PC Power and Cooling today.



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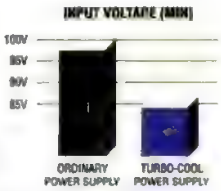

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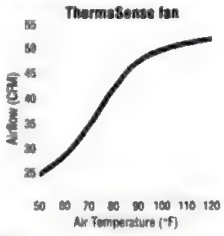

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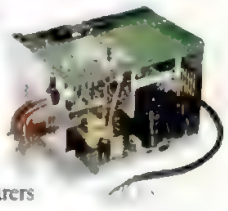
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adding one wait state extends that to three cycles and cuts performance by 50 percent.

System designers use several techniques to improve memory response and avoid wait states: page-mode memory chips, memory interleaving, and memory caching. These three techniques are frequently combined.

Page-mode memory chips use a different silicon design from standard linear-addressed memory chips. This technique allows for repeated memory accesses within a given address range (called a page) without wait states. The Compaq Deskpro/386 uses a slightly different technology to achieve a similar result.

Power supplies are standardized in two physical sizes: one to fit a full-size AT chassis and one to fit a mini-AT case. Towers and small-footprints use special supplies.

Interleaved RAM is arranged in two or more banks and alternates addresses between banks. While one bank is addressed, the other banks can recover for the next operation. A two-way interleave theoretically halves the number of wait states because random reads or writes will come from a bank that's ready in half the time. The actual performance improves because most memory accesses are sequential and naturally alternate between banks.

The drawback to interleaving is the need for multiple banks (an even number for a two-way interleave, a multiple of four for a four-way interleave). With 4MB 9-bit SIMMs, for example, one 32-bit bank totals 16MB; you will need at least 32MB in your PC for a two-way interleave. (Keep reading for a full discussion of memory types.)

The best way to avoid wait states is to add a *memory cache* (also known as a CPU cache or processor RAM cache) to the system configuration. Factors such as the cache's size, organization, and write policy affect its performance, but regardless of those factors, any cache is better than none.

MEMORY CACHING

A cache is a small block of fast but expensive static RAM (SRAM) that operates without wait states, interposed between the processor and slower main memory. A cache controller attempts to anticipate the needs of the microprocessor and fills the cache with the memory contents most likely to be needed next.

A cache hit occurs when needed information is contained in the cache and the microprocessor can access it without wait states. A cache miss means that the needed information is not in the cache and the microprocessor must wait while that information is retrieved from main memory. In general, the larger the cache, the higher the hit rate.

The 486's built-in cache is more efficient than an external cache because it has a direct 128-bit data path to the chip's processing circuitry. Intel limited this size to 8K because its silicon occupies about one-third of the chip substrate. External caches, which must connect to the 486 through its 32-bit data bus, can add performance because they can be as large as you can afford. On PC Magazine benchmark tests, 486DX/50s have previously benefited from a 256K cache, though a 64K cache was generally enough for a 486/33. In general, a cache's effectiveness depends on the software you run. Intel says you probably do not need a secondary cache for DOS, but should use one as large as possible for NetWare, Unix, and other advanced operating systems.

CACHE ORGANIZATION, WRITE POLICIES

Two factors beyond size influence the cache's effectiveness, though significantly less than the mere presence of any cache. These are organization (direct-mapped or set-associative) and write policy (write-through, buffered write-through, or write-back).

A *direct-mapped* cache looks at memory in blocks, and assigns one line of cache memory to each block (a line is the 486 chip's basic data unit, four double-words or 16 bytes). Its ease of design and implementation, as well as its satisfactory DOS and Microsoft Windows performance, makes direct-mapped cache popular among many motherboard manufacturers.

Direct-mapped cache's disadvantage shows up in multitasking environments such as OS/2, Unix, and NetWare, though not necessarily under Windows. Repeated requests for different lines in the same block result in cache misses. These multitasking programs may alternate between two or more tasks, each task calling a different line in the same block. The cache repeatedly loads and unloads between tasks, and therefore, performance can be bogged down. This problem is called *thrashing*.

A *set-associative* cache assigns multiple lines to each main memory block. A two-way set-associative cache gives two caching locations to each block, a four-way set-associative cache gives four locations, and so on. The ability to keep multiple lines in the cache substantially reduces thrashing.

This advantage comes at the penalty of complexity and speed. The cache controller must track two or more lines from each block, checking two or more places to determine whether needed data is in the cache. With every additional way, the cache becomes more complex, and this complexity can impose its own speed limits. Most designers believe a four-way associative cache is the best trade-off between complexity and performance. *PC Magazine* has found that in the 486 environment, under PC Labs' benchmark tests, a 64K four-way set-associative cache is often about as effective as a 256K direct-mapped cache.

The cache's write policy—write-through, posted (or buffered) write-through, or write-back—also has some effect on performance. Caches may operate on all memory operations or be restricted to memory reading. The latter, called *write-through* cache, ignores data to be written to memory and passes writing in-

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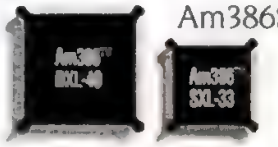

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structions directly to system memory without trying to cache it. If the microprocessor writes to a line that is already stored in the cache, that line will be updated in the cache and main memory simultaneously.

A *posted write-through* cache (sometimes called buffered or lazy write-through, or simply posted-write) delays writes to memory until the CPU moves to a non-memory operation. At that time, the contents of the buffer are written to main memory.

A *write-back cache* intercepts both read and write operations. Although the write-back cache improves performance (30 percent of all memory operations are writes), it also increases complexity and adds its own problems. The cache controller must constantly assure that cache memory and main memory contain the same information so that other devices in the system do not try to read data from main memory before it is updated from the cache. There is also always a risk that main memory will not be properly updated by the cache.

Solving the problems associated with complex cache structures (such as write-back cache) is beyond the capabilities of some motherboard makers. Consequently, most inexpensive boards include only direct-mapped, write-through caches. For everyday DOS applications, this design should suffice, but more complex operating systems may benefit from the more advanced cache organizations and write policies.

CHIP SETS AND BIOSES

Most modern PCs are built from *chip sets* that take all the individual, or discrete, circuit components and combine them into one, two, or three ASICs (application-specific integrated circuits). No current computer uses discrete circuitry; as a rule, the more functions integrated on a chip and the fewer chips on the motherboard, the more reliable the system.

A high scale of chip set integration lowers cost and improves system reliability because fewer components and connections can fail. But a single chip computer may not be the best. For example, OPTi offers both one- and three-chip PC implementations, noting that while the former is simple, the latter allows for more versatility in system design—which means a greater ability to tune in more speed.

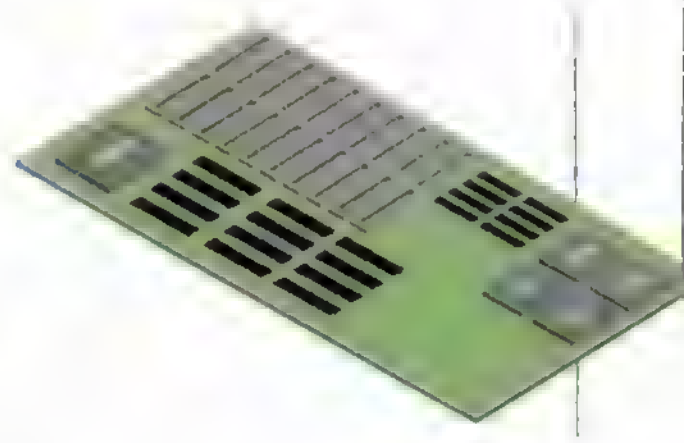
The chip set usually determines the incidental features built into a system board: floppy disk control circuitry, input/output ports (parallel, serial, mouse, keyboard, and game ports), and a connector for an embedded-controller hard disk, such as an IDE hard disk. Some manufacturers incorporate VGA circuitry into the chip set as well. In a small footprint PC, putting features such as VGA circuitry on the system board maximizes the number of slots available for other expansion. Otherwise, the location of these features, is immaterial.

Implementing the I/O ports through a chip set can be economical and has no effect on performance. Consequently, most major system vendors now put their port circuitry on the system board (typically one parallel and two serial ports). But in the price-sensitive replacement motherboard industry, it is cheaper to forego the extra circuitry, connectors, and board space associated with ports and slide in a cheap expansion board instead. For an end user, whether ports are on the motherboard is not a major issue as long as you have enough space on your motherboard for other adapters. You can add a multiport board (with attachments for a floppy disk drive, two serial, one parallel and one game port, and an AT Attachment connector for an IDE hard disk) to a PC for about $20.

The only important issue to consider is whether port, video, and floppy disk control circuitry on the motherboard can be defeated to eliminate I/O and interrupt conflicts with other expansion products. (IDE ports do not need defeatability because an unused IDE port acts as an expansion connector without having anything plugged in.)

Note that motherboard video is not necessarily the same as local-bus video, which provides a high-speed connection between the microprocessor and the video controller. Motherboard video affords no real performance advantages or disadvantages, though on-board video does save an expansion slot. The drawback of on-board video is, of course, that you lose its value if you decide that you want to upgrade your video system. In addition, the motherboard must provide a VGA or VESA feature connector so that you can plug in display enhancements that require such a connection (for example, 8514/A graphics adapters and graphic coprocessors).

Motherboard makers use several techniques to improve memory response and avoid wait states: page-mode memory chips, memory interleaving, and memory caching.



The *Basic Input/Output System* (BIOS) is a set of program instructions held in read-only memory (ROM). These instructions provide programs with a common means of activating system functions that is independent of the underlying hardware design. In effect, the BIOS determines the software compatibility of motherboard hardware. Although manufacturers such as IBM, Compaq, and a few others make their own BIOSes, most vendors sell systems based on Award, AMI, or Phoenix BIOSes. These BIOSes may not be interchangeable among different systems, but they can often be updated by physically replacing the chip. Some PCs are built with flash memory, which allows you to update the system BIOS from a disk provided by the computer's maker.

The BIOS interacts with the chip set and overall motherboard design to determine ultimate system performance. Some BIOSes do better jobs than others at taking advantage of chip set features.

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Processor and Memory: *50-to-1 Performance Boost from XT to 486*

The fastest PC available, a 50-MHz 486, is more than 50 times as fast as the original IBM PC and PC-XT. But within the categories you should consider (386 or better), each chip is around 20 to 30 percent faster than the next-slowest.

To illustrate some of these differences, PC Magazine Labs built its own computer test-bed. Our benchmark tests showed that technical intuition and product specs are right: 486-based systems are consistently faster than 386s, regardless of the clock speed; within any CPU category, the improvement in processor performance is directly proportional to the clock-rate increase; and there is little difference in processor or memory performance between ISA and EISA under our DOS-based tests.

Our test-bed consisted of a 340MB Maxtor IDE hard disk, a TEAC floppy disk drive, a monitor, an ATI Integra VGA adapter, a keyboard, and a 300-watt PC Power & Cooling power supply. We connected these components to each of nine motherboards and ran the processor and memory tests from PC Magazine Labs' Hardware Performance Tests, Release 6.0.

American Megatrends Inc. (AMI) supplied the motherboards: EISA-based 486DX/50 and 486DX/33 Enterprise II boards, ISA-based 486SX/25 and 486DX/33 Series 50 Super Voyager boards, 386DX/33 and Am386/40 Mark V Baby Screamer boards, and 386SX/20 and 386SX/25 SX-Cache II boards. We also used its 486SX/25 Super Voyager with an Intel DX2/50 clock doubler.

Each motherboard contained 8MB of RAM. Caches varied, however, from board to board. The 486DX/50 and 486DX/33 boards contained 128K of external write-through cache. The 486SX/25, 486DX/33, 386DX/33, and Am386/40 boards contained 64KB of write-back cache. The 386SX boards held 32K write-through caches.

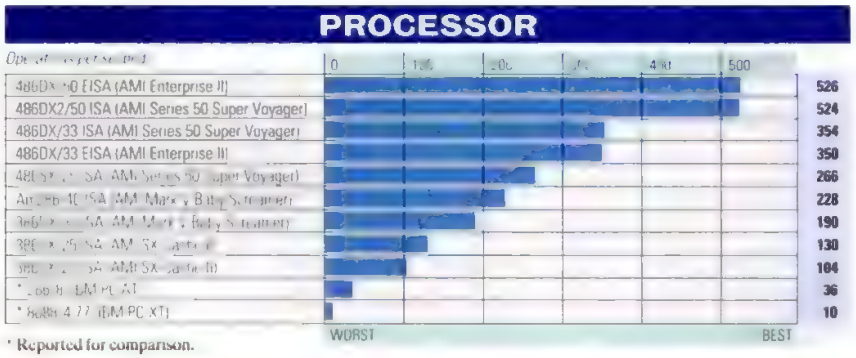
The 33-MHz 486DX ISA motherboard processor ran 1.8 times as fast as its 386DX/33 counterpart and just about matched the EISA 486DX/33, showing that bus architecture has no effect on processor performance.

Our tests also showed that the 486SX/25 board with a DX2 clock doubler lived up to its name: When we replaced the 486SX/25 motherboard's CPU with a 486DX2/50, the processor performance doubled and the memory performance increased by 60 percent. The 486DX2/50 and 486DX/50 scores were within 3 percent of each other on the processor and memory tests. Highly memory-intensive operations may bear different results since the 486DX2 chip transfers data to memory at a rate of 25 MHz.

Within CPU classes—386SX, 386DX, 486SX, and 486DX—processor scores increased in direct proportion to the percent increases in clock speed: The 486DX/50 produced 50 percent more operations than the 486DX/33, the 486DX/33 was 33 percent faster than the 486SX/25 (our tests do not use the 486DX's built-in math coprocessor), the Am386/40 was 20 percent faster than the 386DX/33, and the 386SX/25 was 25 percent faster than the 386SX/20.

Memory and processor scores frequently increased in proportion to each other. For example, the 386SX/25 showed processor and memory scores that were each about 25 percent faster than the 386SX/20's scores; the Am386DX/40 was 20 percent faster than the 386DX/33, and the 486DX/33 was roughly 30 percent faster than the 486SX/25.

When compared with the 486DX/33, the 486DX2/50's memory score showed the limitations of that chip's 25-MHz external data path, however: Though the 486DX2/50's processor score was nearly 50 percent faster than that of the 486DX/33, its memory score was only 23 percent faster.



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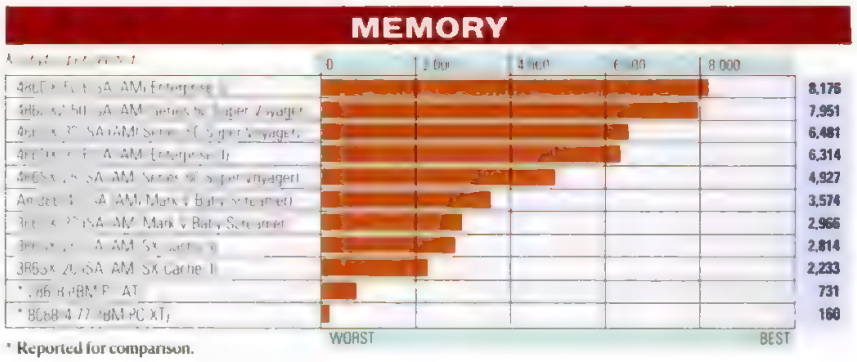

* Reported for comparison.

AT LAST... OS/2 2.0 MAKES A GRAND ENTRANCE

In the 11 years since the introduction of the IBM PC, users have significantly upgraded almost every aspect of their computers—except the operating system. Now, for the first time, they have the opportunity to do just that. Even if DOS hasn't entirely outlived its usefulness, OS/2 2.0 offers features and power that can benefit all users of Intel-based computers.

Consider that the original MS-DOS, on which subsequent versions were based, was written to support what was then considered the advanced abilities of the 8088 processor. Four processor generations later, OS/2 has arrived to support the hardware power that has evolved over the last decade—most significantly, the ability of a single processor to sustain a multitude of tasks; to run one application in the foreground while supporting several other background functions. Simply put, a new operating system offers users the ability to install a new foundation under an existing structure.

The power of OS/2 is legion. If you've read the news coverage or talked to early users, you know of the new operating system's five basic advantages over all its PC predecessors: multitasking, multithreading, the ability to run DOS and Windows applications, bulletproof memory protection, and 32-bit operation. Together, these abilities will take your systems where no PC has gone before.

Even those who can rattle off these OS/2 capabilities may not be sure what they actually mean or how the new features can benefit their computing lives. For those who know that something meaningful is going on but who are not sure what it is, here's a guide to OS/2 buzzwords and their importance.

It's been a long time coming, but OS/2 2.0 is the operating system we've been waiting for. Finally, PC users can tap all that power on their desktops.

❖ MULTITASKING

The ability to run more than one application at a time while coordinating and exchanging data between the separate programs. Most important, adding another program to the mix in OS/2 doesn't slow the machine—or the other applications—down.

Those who have "multitasked" under Windows only know half of the story. OS/2, in fact, truly offers the ability to run several applications, where adding another task doesn't degrade the system as a whole. Windows, on the other hand, slows down its operation whenever another task begins.

The disparity between Windows and OS/2 is, respectively, the difference between cooperative and preemptive multitasking. As a fully preemptive system, OS/2 allocates processor time to the functions of greatest importance. The software developer sets priorities for separate functions, so a specific task is either immediately addressed or preempted in favor of another. Based on these priorities, the system determines which tasks should be completed first and which need to be shared.

The advantages of preemptive multitasking go to the heart of PC use. For instance, little jobs like formatting a diskette or downloading a file don't require you to stop working on a document or database. Since one of the most important uses of OS/2 is the ability to connect mainframes and PCs, the time-consuming connectivity functions can be accomplished in the background.

Many people are using OS/2 to interact with larger computers in a mixed environment; this interaction becomes one task on the desktop. "We believe in the marriage of data processing and personal productivity tools," says an assistant vice president at the Bank of New York in Manhattan. "We have implemented a system that allows us to use existing 3270 communication systems as part of OS/2 applications. We have down-

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loaded some of the processing that used to occur on the mainframe and adapted them to a client-server situation." The results, he says, are easier for the individual to manipulate and understand.

OS/2 can change your options. "With OS/2, we are looking at a new type of application development," says Eric Jones, manager of data services and development for the Arizona Department of Transportation in Phoenix. "This is a multilayered approach. We have LANs talking to each other, requests for distributed data, and other functions that coordinate servers and plotters. With OS/2, these types of multiple applications seem to work best. As for our own needs, we have progressed beyond the simple applications possible under Windows."

Users and developers, then, need to get used to the idea of doing more than one thing at a time. Jim Gilliland, manager of tax systems for BP America, in Cleveland, Ohio, is always running some type of communications session in the background of his desktop PC. He runs a single-line bulletin board from this machine, and his two asynchronous communication ports are often sending and receiving data simultaneously. At the same time, he might be printing one document and editing another.

Charles Dirks, technical project leader for Saabre Computer Services in Tulsa, Oklahoma (a division of American Airlines), is designing an OS/2 application that connects to what he calls "one of the largest computer systems in the free world." This system, once implemented, will handle more than 3,200 messages a second and enable airline reservation clerks to access a wider range of information. For instance, how many Smiths may be flying on a particular airplane? To accomplish this, the computer must be able to perform local and remote tasks simultaneously, with no degradation.

Like the old saw that says the most dangerous part of a car is the nut behind the wheel, the greatest adjustment to multitasking may be in human terms. Users are accustomed to taking a coffee break or staring at the screen as the cursor turns into an hourglass. Under OS/2, people will need to change their style and get used to the idea that they don't have to slow down after issuing the command to format a disk or print a file.

> BOTH users and developers of OS/2 2.0 need to get used to the idea of doing more than one thing at a time.

"With DOS and other single-thread products you issue a command and then wait," Dirks says. "Under OS/2 you can issue a command and wait just out of habit. It takes a change in the way you work to realize that you can switch to another task."

❖ MULTITHREADING

The ability of a single program to execute several functions concurrently. The separate "threads" complete their tasks in the background and allow continued operation of the primary assignment. A cousin to multitasking, multithreading assigns separate program functions different "threads."

The efficacy of multithreading depends on the user's need to execute more than one aspect of a program at a single time. Common examples of this include printing and editing in a word processor, recalculating and revising a spreadsheet, or executing a database search while updating records.

In a multithreaded program, each thread can perform its task independently. Older operating systems achieve parallel execution by creating multiple processes, which involve lots of overhead. In OS/2, these processes share access to the resources of the operating system and, as a result, run more efficiently.

A real-world demonstration of multithreading is only as far away as the nearest Target variety store. Each outlet of the massive chain has an OS/2-driven machine connected to several hand-held radio terminals to manage inventory. Each terminal is engaged in a different stage of the retail operation and is coordinated by the host computer. Subsequently, the information is made immediately available to the firm's Minneapolis headquarters. Says Target senior technical analyst Gary Johnson: "We are transmitting data from the hand-held units at the same time we are sending data to and from the central site. We use all this as a basis for restocking."

Gilliland says, "Communications software in particular can take real advantage of the multithreading environment, where the keyboard can be sending information to one COMM port while information from a second port is moving directly to disk."

While the potential is obvious, not all software can benefit from multithreading. A single-function program, like a decompression utility, only uses and needs one thread. Similarly, multithreading is the one aspect of OS/2 that does not translate when a program is ported directly over from DOS or Windows. According to Gilliland, that shouldn't discourage developers. He says it doesn't take much work to place a Windows program into the OS/2 environment. "There is no excuse for any Windows developer not to come out with an OS/2 version," he says.

❖ RUNS DOS AND WINDOWS

The ability to run DOS, Windows, and OS/2 programs in a single environment. While programs from other environments don't share the intrinsic benefits of OS/2, they can run as separate tasks under the new operating system.

OS/2 2.0 promised a "better DOS

than DOS and a better Windows than Windows" for some time. The latter promise, however, was not immediately fulfilled: The Windows iteration included in the initial shipment of OS/2 2.0 was the already outdated Version 3.0. The DOS iteration (Version 5.0), however, was stable and up-to-date. The ability to run several DOS sessions simultaneously pleased those who had a considerable investment in older software programs.

OS/2's ability to run older software saves both time and money. You don't have to purchase new applications, or submit to relearning and retraining. DOS and Windows applications won't incorporate multithreading or 32-bit operation, but they can work as a single task in a multitasking environment and benefit from memory protection.

"I don't have to upgrade any of my previous applications," says David Eller, systems analyst for Sherrill Furniture in Hickory, North Carolina. "DOS and Windows programs run unmodified, and often perform better under OS/2. For instance, one dBASE application took 16 minutes to run under DOS and only 12 under OS/2."

Eller adds that an OS/2 upgrade is actually less expensive than coaxing a DOS machine to perform the same function. "With all the things you need to buy—DOS itself, DESQview, and various extenders—it can add up to a few hundred dollars per machine. So the [$49–$129]

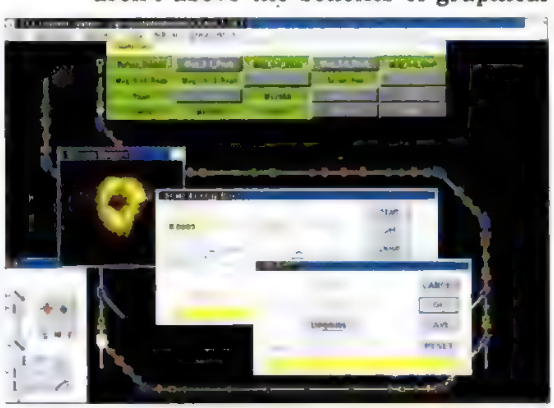
◆ OS/2 CASE STUDY ◆

OS/2 Pulls Lasers Around the Corner

While most OS/2 users see the advantage of the powerful new operating system as a boon for business, some are using the system in more esoteric ways—to test the limits of science and technology.

Laser experiments at the University of California's Quantum Institute in Santa Barbara are helping to determine the properties and limitations of a mysterious beam called a free electron laser (FEL). The FEL is a research tool that produces far-infrared radiation at frequencies just beyond the reach of conventional, high-speed semiconductor electronics. The key to controlling the FEL is a PC system equipped with OS/2.

Bruce Wallace, development engineer at Quantum, lauds the system's combined power and ease of use that are due to the graphical interface. "A GUI simplifies the advanced features of the equipment," he says. "Real-world functions are given graphical representations, which make it easier for the end user to comprehend what is happening and adjust components as needed." When Wallace says "end user," he means "scientist." High-level users aren't above the benefits of graphical systems.



OS/2 2.0 enables UCSB scientists to see and adjust the magnets controlling the laser's path easily, and to monitor diagnostic processes. This real-time interaction increases success rates.

Wallace's experiments make use of all of OS/2's advanced computing features. OS/2's multitasking capacity speeds the development of applications by allowing application developers to compile in one window and edit in another. Multitasking allows low-priority tasks such as long, intensive calculations to be run in the background so that work can continue on other tasks in the foreground. Multithreading tracks critical background tasks for the laser monitoring system. This system checks the operation of the laser and provides a graphical representation of background functions. Finally, the OS/2 DOS box allows DOS-based scientific applications to be run from within OS/2. The DOS applications don't need to be ported to OS/2.

The operation of OS/2 also provides additional benefits: Using a 32-bit processor speeds up computation-intensive work, allowing an experiment to be completed in a shorter period of time; and memory protection makes sure that when an application crashes because of programming aberrations, it doesn't shut down the entire machine.

"The most exciting aspect of OS/2 2.0 will be its application in a 32-bit operating environment," Wallace says. "32-bit addressing will speed up computational-intensive work, and the graphics engine will provide faster redraws of complex screen images."

The OS/2 system represents the third-generation control system for the FEL. The first had 70 analog knobs and evolved to a DEC LSI 11 system.

"OS/2 has lessened the complexity of running the laser," Wallace says. "We have magnets and diagnostic equipment that need to be calibrated. Now, we can do it dynamically. The computer changes each one either individually or as a group. You couldn't do this with analog control."

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upgrade to OS/2 is a lot cheaper."

Hosting DOS and Windows is a convenience that preserves the software investment and eases the transition. Many, like Gilliland, don't want to waste too much time on a system that won't meet their multitasking needs. "We are running a few DOS apps," he says. "But we are not interested in running Windows. It involves another layer of emulation, where you are wasting system horsepower. There is an awful lot of overhead under Windows and OS/2 combined."

❖ BULLETPROOF MEMORY PROTECTION

The ability to create a separate memory workspace that can't be invaded by other applications. By creating an absolute memory boundary, a program can neither corrupt another application nor be corrupted itself.

Memory protection assigns each active application absolute boundaries, beyond which it cannot stray. One application is prevented from accessing memory that is in use by another. So if one program should crash, it will not affect the operation of the rest of the system. Since most system crashes—in DOS, Windows, and elsewhere—are caused by memory conflicts, this adds considerable stability to the environment.

Bulletproof memory protection increases system reliability to the point where many users never have to reboot. If a program crashes it is restarted without impacting the rest of the system. It is impossible for the behavior of one application program to impact the performance of another.

Memory protection is another area that sets a "real" OS above the others, and is one aspect that current OS/2 users and developers already take for granted. Says Jones "Over time this protection will become a requirement. The situation when you have one application clobbering another is intolerable."

"If Windows receives a message it cannot interpret, it will crash," a user at a large bank says. "In a preemptive multitasking environment, such as OS/2, a program is given an area in memory that no one else can talk to. If something happens to that program, you don't corrupt your other applications."

Like many OS/2 advantages, memory protection's potential exceeds its current implementation. Before commercial applications appear in quantity, many of the operating system's benefits will be more valuable to developers than to end users. OS/2 makes it more productive to develop custom corporate applications and easier to find and fix specific problems. End users, consequently, may find that the program is of a higher quality because of the more efficient nature of the development process.

Saabre's Dirks tells of periodic mainframe "dumps" where a frozen system would destroy a great deal of a programmer's work. In those instances, the programmer had no choice but to start over from scratch. Thanks to OS/2, these problems are history.

> BULLETPROOF MEMORY PROTECTION increases system reliability to the point where many users never have to reboot.

"These dumps used to be weekly events," he says. "If we were a small shop and were losing that much work, we would have been out of business. But we haven't had one in the year and a half since we shifted our programming efforts over to OS/2. With memory protection, it alerts you to errors and prevents you from addressing or manipulating storage outside of where you should be. It's a lot cleaner."

Eller takes advantage of memory protection to supply phone support for users throughout his company, who tend to use disparate software programs. He can load any program on his own machine in its own virtual space, then walk the user through the specific problem or question. Some of the older software, unsurprisingly, is unstable and would corrupt any other environment.

❖ 32-BIT OPERATION

Using the 32-bit architecture for program execution. With a 32-bit data path—as opposed to a 16-bit data path—OS/2 relieves a tremendous bottleneck and everything moves at a much faster rate.

Speed, in and of itself, has always been one of the prime motivations for an upgrade. IBM estimates the OS/2 system will offer a 30 percent performance improvement, mostly due to the 32-bit architecture. The company even goes out on a limb and states that some applications will double their speed.

The ability to move information through a 32-bit channel is the heart of this performance advantage. 32-bit operation addresses the special requirements brought about by today's processor-intensive applications: the need to move heavy graphics, sizable bitmaps, and blocks of numerical data.

So far, true 32-bit applications are few; the advantage is more of a promise than a reality. Even so, this is the aspect of OS/2 that tends to get the most immediate reaction. Any application running in a 32-bit environment will appear faster. And since PCs can never be too fast, many users will buy OS/2 just for that reason.

Says one IS director, "I'm not sure how to sell the benefits of multithreading, but it's an easy sale to say that 32 bits is twice as fast as 16. A 32-bit system is much, much faster. More instructions can be handled by the chips, and a larger assortment of functions are possible. It can't be oversold, as it stands to bring applications some substantial benefits." ◆

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ANTE UP FOR OS/2

Those new to OS/2 are finding that the cost of upgrading to the new operating system doesn't end (or necessarily begin) with purchasing the software. Depending on the configuration, today's average PC will probably need to be outfitted with additional hardware before it can accommodate OS/2. The upgrade can range from a few megabytes of RAM to a complete processor overhaul or a new hard disk.

Like other environments, OS/2 can always benefit from more RAM, a faster processor, and a larger, faster hard disk. Only the entry stakes are higher, and the limitations now come from the hardware. So, if the bad news is that an upgrade is needed to stay on personal computing's cutting edge, the good news is that any medium-to high-powered PC—including one optimized for Windows—will transfer those performance advantages to OS/2. Also, while OS/2's entry-level platform might seem a tad high by today's standard, with the way memory prices are falling and the way faster chips are being introduced into the market, these requirements should be fairly commonplace within a year.

As David Eller, a systems analyst for Sherrill Furniture in Hickory, North Carolina, puts it, "For the first time, we have a razzle-dazzle operating system that can take advantage of all this fancy hardware." Before too long, desktop machines with 64 MB of RAM and a few gigabytes of hard disk space—a desktop mainframe—may be common, if not commonplace.

Hardware requirements for OS/2 are application dependent, and flexible. Additional memory may obviate the need for a faster processor, and vice versa. Still, there are standards to be met. Let's look at the hardware pieces.

❖ PROCESSOR

As a full 32-bit operating system, OS/2 obviously needs a 32-bit processor (a 386 or 486) to even start its engines. Anyone with a 286-based PC must either submit to a relatively painful processor upgrade or get a new machine. OS/2 proponents recommend using the fastest processor that you can afford. Even so, they maintain that the system will run at least competently on any 32-bit processor—even exceeding Windows' performance on the same hardware. Moreover, early reports from users seem to indicate that even 16 MHz may be enough. OS/2 developer Doug Hamilton professes that a 16-MHz machine—DX or SX—will be satisfactory in some cases where performance isn't crucial.

The power of this operating system will probably force you to upgrade your hardware.

One made-for-OS/2 solution comes from the SLC processor found in the PS/2 models 56 and 57 and the 386 SX Ultimedia machine. The SLC chip is a modified SL chip with 8K cache and an optimized instruction set. It works up to 88 percent faster than others in its class, according to IBM.

❖ MEMORY

In the same way that you can run Windows on a machine with only 2 MB of RAM, you can run OS/2 in an environment with double that RAM. In either case, what is possible isn't necessarily advisable. Increasing the amount of RAM on a Windows machine to 4 MB or more results in a perceptible increase in performance; OS/2 really performs better after crossing the 6-MB mark.

If memory is the only thing you need to prepare a PC for OS/2, then the cost will not be prohibitive. With RAM prices hovering around an acceptable $50 per MB, it will cost just a few hundred dollars to bring a machine up to speed if you are starting from scratch.

Fred Rodriguez, supervisor of in-house development and conservation programs for the Los Angeles Department of Water and Power, has 50 machines under his purview, and has made most of them OS/2 capable. "We've made a real turnaround, from being really worried about spending money on memory to today, where it's not a concern," he says. "I'm even adding more [memory] than we need in some cases, in anticipation of future graphical applications that will push the hardware requirements."

The standard OS/2 machine used by the Los Angeles Department of Water and Power contains 8 MB. This translates into a standard upgrade of $300 per machine. Rodriguez adds that a non-networked machine might require less memory, but he has allocated the standalone machines in his shop to graphical applications. As a

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general rule, a network machine may require more memory if it does not have extra room on the local hard disk to act as a swap file.

There is no visible ceiling for OS/2 upgrades. "OS/2 is restricted only by the limitations of hardware, and your pocketbook," says an IBM source. "It's like 'if you want to play, you have to pay.' The more memory you get, the more speed you get, and the more it will cost."

❖ HARD DISK

Hard disk size is one area where OS/2 requirements slightly exceed those for Windows. Even if the average new machine contains a drive size of 120 MB or more, this is real estate that isn't likely to stay undeveloped for long. Consider the size of the system itself. With all the bells, whistles, and "applets," OS/2 occupies almost 30 MB. After some time, you may decide to delete some of these utilities (some of which have the same order of power as the Windows Calendar or Cardfile) and trim the operating system down to a relatively svelte 16 MB.

"There are some ways to trim down hard disk requirements," says Hamilton. "A lot of the sample applications are real junk, but a new user doesn't know what's junk and what's not. And they will feel uncomfortable leaving stuff out."

Rodriguez adds: "Most of our people want it all, and it's not always easy to find machines with 30 MB free. So we allocate machines, or erase Windows from their disks—which they don't really need if they are running OS/2."

In terms of applications, you can expect OS/2 programs to follow the lead of Windows, where programs occupy 5 MB to 15 MB each. Again, some of these programs are not selective in their installation and may dump a range of unneeded or unwanted functions as part of the software installation process.

OS/2 Hardware:

GREAT EXPECTATIONS

PROCESSOR
Acceptable Minimum: **20-MHz 386SX**
Recommended: **25-MHz or faster 386 or 486**

MEMORY
Acceptable Minimum: **4MB**
Recommended: **8MB or more**

HARD DISK
Acceptable Minimum: **40MB**
Recommended: **100MB or more**

VIDEO
Acceptable Minimum: **VGA**
Recommended: **VGA**

While some early users claim that OS/2 performs well on hard disks slower than 20 ms, most hardware experts prefer media at least as spry as that recommended for Windows: 17 ms or faster. Another consideration is the choice between standard IDE and the more flexible SCSI drives. For expandability and system performance, a chain of SCSI drives may prove to be better multitasking hosts, allowing a smarter allocation of hardware resources.

Another way to save hard disk resources will come from data compression. Stac Electronics, located in Carlsbad, California, plans to release an OS/2 version of its compression utility, Stacker, by the end of 1992. Like its popular DOS package, Stac for OS/2 will compress files up to 50 percent (executable files don't compress as well as data files) and will work either in software only or in conjunction with its expansion card.

❖ VIDEO

Graphics is one area for which OS/2 must hang out the dreaded "Under Construction" shingle. While the system thrives under VGA, 8514, and XGA (which, from all reports, runs slowly under OS/2), the first release of OS/2 does not support SVGA, the higher resolution VGA specification that has become the Windows standard. Video drivers supporting SVGA will, according to IBM, be available from the graphics card manufacturers or as downloadable files from CompuServe and other on-line services.

❖ WHITHER MICROCHANNEL?

IBM presented Microchannel, a multibus hardware system, in a simultaneous 1987 introduction with the original version of OS/2. Unsurprisingly, many users came away with the idea that one would not work without the other. Today, relatively few manufacturers offer Microchannel machines, opting instead for ISA or EISA standards. This doesn't affect the use of OS/2.

"You don't need an IBM Microchannel machine to take advantage of OS/2," says an IBM source. "You can get the same benefits with either an EISA or ISA machine. It depends on what you can afford."

Some users select PS/2 machines not for their Microchannel architecture, but for their pro-active customer and technical support. According to one user, "Microchannel makes sense because it is what IBM is selling. If your business stops when the machine stops, then it is important that your vendor know that anything that works with its machines and DOS will also be able to migrate to OS/2."

"In general, we've found that OS/2 seems to handle any hardware we throw at it," says Jim Gilliland, manager of tax systems for BP America in Cleveland, Ohio. "It works with clones, unusual hard disks, and different types of mice. For the most part, most people can just throw it on their system, and away they go." ◆

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TOOLS FOR OS/2 DEVELOPMENT:

WORKS IN PROGRESS

Commercial developers are hustling to provide applications to take advantage of the OS/2 operating system. There's great incentive: If they are the first on the market with a program that exploits an OS/2 advantage, they stand a chance to dominate an area of OS/2 applications.

While all eyes are upon independent software developers to deliver the goods, corporate developers are taking matters into their own hands. As with other environments, if they want to do something very specific under OS/2, they may need to do it themselves. Often, this "do it yourself" software development involves the combination and coordination of desktop programs and mainframe connectivity.

"Right now, I don't see a broad range of tools available for OS/2," says Bruce Wallace, development engineer for the Quantum Institute at the University of California in Santa Barbara. "Everyone wants to get into 32-bit programming, but the tools aren't there in mass quantity. But these tools will definitely increase. If OS/2 2.0 sells, there will be a proliferation of tools. And this will allow everyone to start [developing] at a higher level."

❖ DEVELOPING IN THE GREAT WIDE OPEN

Today, OS/2 opens up a memory prairie, a virtual Lower 40 of possibilities. As a 32-bit operating system, it can address up to 4 gigabytes of memory (although OS/2 2.0 can presently only handle 512 MB) and delivers significantly better performance than its 16-bit counterparts.

With all of the raw horsepower in 80386 and 80486 chips that OS/2 is able to capitalize on, developers will be able to write larger, more complex applications without the time sink devoted to performance tweaking that has become part of life under DOS and Windows.

OS/2 offers true multitasking. All you need are the right development tools, and they are close at hand.

Under DOS, multimedia and imaging applications have pushed the traditional limits of performance and memory consumption. Developers feel that OS/2 2.0 creates a new and exciting environment that demolishes those barriers. Even so, some corporate developers may have problems harnessing OS/2's subtleties. The best object-oriented programmers are currently in the employ of independent software vendors, and not in the ranks of corporations. This situation, however, will rectify itself as more people learn about OOP (object-oriented programming).

The abolition of memory segmentation in OS/2 2.0 makes for simpler applications; you don't have to worry about how the machine will actually execute your code. This is a vast improvement. The earlier memory segmentation scheme was, in the words of Pin Foo, vice president of engineering at Saros Corp., a Bellevue, Washington–based developer of client/server applications, "like asking Charles Dickens to write the *Tale of Two Cities* on the back of a series of business cards."

With its support of DOS and Windows, OS/2 pleases customers and developers who have prior investments in these environments. "We run IBM's VM operating system on the host, and we draw the analogy to OS/2 all the time—it's VM for the desktop," says Alan Edmonds, manager of end-user computing at Victoria Bankshares Corp., an Austin, Texas–based bank-holding company.

❖ OS/2 AND THE LAN

The phenomenal growth of LANs and the need to access distributed data have also raised users' expectations of what a PC should do. With the communications capabilities of IBM's Extended Services (formerly Extended Edition), multiple communications sessions can run in the background while other tasks are performed.

Bob Lee, development manager

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for Lotus's spreadsheet division, has made extensive use of threads to extend 1-2-3's communications capability. "Our DataQuery facility, where data resident in SQL databases is made available to 1-2-3, runs as a separate thread," he says. "The retrieval can take place in the background while control is returned to the user for other tasks." In the same manner, 3270 host links, LAN connections, and other communications sessions can be relegated to the background and made transparent to the user.

The power and performance, simpler memory management, DOS and Windows support, and multitasking capabilities add up to more programmer productivity, faster applications, and increased power in the hands of the user.

❖ MOVING FROM WINDOWS

Part of enhancing programmer productivity is OS/2's ability to leverage existing applications. As Microsoft continues to point out, there are many more commercial Windows programs than OS/2 programs, and developers have had a couple of years to build applications based on them. IBM took a practical approach to

DEVELOPER'S HEAVEN

A look at some of the internals of OS/2 that make it attractive for application development.

Like any complex technical system, OS/2 has a myriad of "internals" that control the interaction of complementary functions. There are several exciting aspects of OS/2 that are whetting developer's appetites to get started. These real-world advantages can make developing an OS/2 application—dare we say it—fun.

OBJECTS LEAD THE WAY

At the forefront of this group of internals is a new user interface, the Workplace Shell (WPS). Built as an extension to the existing Presentation Manager, the shell is an object-oriented, graphical environment that offers a desktop working area. On the desktop, icons represent resources such as data files, programs, and physical devices like printers and network servers.

Just like a student learning a second language, it is often the irregularities of the interface that cause novice GUI users to lose faith and become frustrated. IBM, in taking an object-oriented approach to developing the WPS, has created an environment where similar actions on the part of the user will be rewarded with similar results.

For example, selecting a data file by clicking on it and then dragging it to another icon, such as the printer icon, will cause the second object to act on the first (in this case, printing the file). Consequently, dropping a file onto the Shredder icon will delete it from the system.

This consistency is made possible by the underlying architecture of the WPS, a facility that IBM calls the System Object Model (SOM). This is a specification and series of utilities that helps develop graphical applications in OS/2. All of the components that are used to construct the shell, including controls and dialog boxes, are defined as objects in SOM.

A standard object consists of a series of attributes and methods that may be modified individually. An attribute may be the color or font used to display the object, and a method might be the way memory is allocated to the object when it's activated. Objects are grouped into classes and subclasses and each layer of the hierarchy inherits its attributes and methods from its immediate parent.

SOM COOL STUFF

The real payback in this approach is the ability to build graphical applications using a building-block approach. To build a desktop object that looks like the local drive icon in the WPS but represents host data files, you create a new object in SOM and define it as being just like the drive object. You create an application with minimal effort by simply changing the data access method of the new object to extract data from a host system. At the same time, you adhere to the look and feel of the WPS, providing a consistent interface to the user.

SOM is language independent, but the initial release will only support C. The supplied SOM compiler produces skeletal C source code to which the programmer can add the specific modifications required and recompile. IBM plans to add support for other procedural languages such as COBOL and object-oriented languages like Smalltalk and C++.

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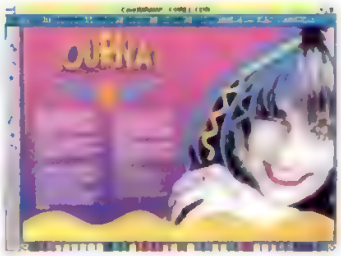

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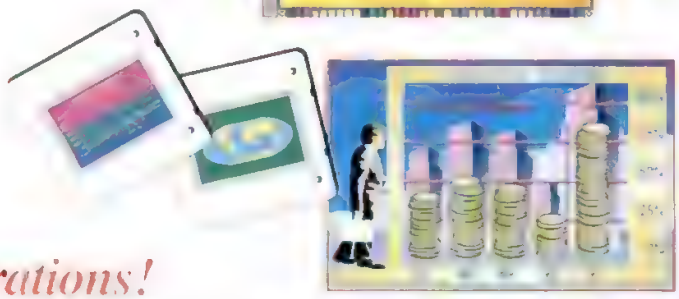

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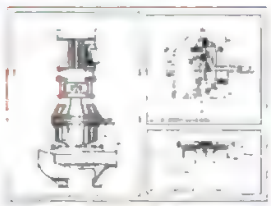

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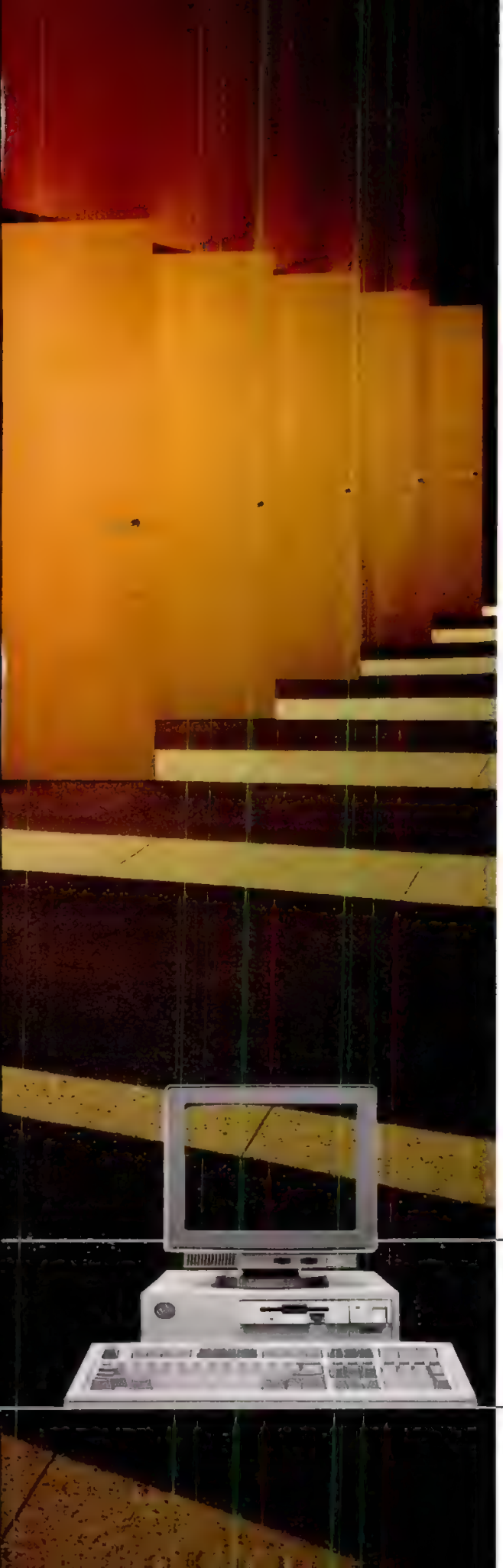

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IBM

answering this challenge—the company has included Micrografx Mirrors and Oasis technology in OS/2, Version 2.0.

Mirrors provides a straightforward way to port existing Windows applications to OS/2 2.0. The developer relinks the Windows application, which will then look and act as if it were a native Presentation Manager application. For an example of how well Mirrors works, you can look at PM Chart, the desktop accessory in OS/2 2.0. Similarly, Oasis is a porting tool for Windows printer drivers, which you can see exemplified in OS/2's HP Paintjet driver that Micrografx ported from Windows. Mirrors also enables developers to write a common set of source code that supports both Windows and OS/2 and extend it with modules that exploit one environment or the other.

IBM's Software Migration Kit includes Mirrors and Oasis. OS/2 2.0 ships with a runtime version of both products, which means that developers neither have to install and manage multiple versions nor give up floppy disk space to those functions.

Micrografx is also writing OS/2 2.0's 32-bit graphics engine, which will expand overall OS/2 performance.

Continues from previous page

While SOM does not pretend to be a general-purpose object-definition language, it does provide significant flexibility in building WPS-compliant graphical interfaces.

RING IN THE NEW

OS/2's structure guides programmers through the development process so that they make fewer mistakes. Taking advantage of the management scheme built into the Intel 80386 and 80486 chips, OS/2 provides a layer of services to protect you from any misbehaving application. This scheme, called Rings, contains four levels of privilege that can be assigned to any task. Each ring, numbered from 0 to 3, has its own characteristics and plays a particular role.

Ring 0 is the most privileged or trusted ring, otherwise known as the supervisor state rather than the user state of the operating system. Ring 0 is reserved for the core functions or kernel of the operating system. Ring 1 is not used by OS/2 2.0. Ring 2 is used by application services like database managers or communications support services and has less authority than Ring 0 but more than Ring 3, which is where all user applications run. The outermost ring has almost no "privilege" or access to the fundamental workings of the system.

The important part of the Rings scheme is that it prevents applications from hurting each other—a combination air bag and seat belt—so that when an application does something that is detrimental to the overall environment, the operating system intercepts the problem and keeps it from disturbing other programs.

In OS/2 2.0, every DOS and Windows session runs in Ring 3. This keeps the potential problems in the outer limits; the applications that would have caused your old operating system to crash are kept at a distance. Safety and security are important concepts in OS/2. The operating system acts as an arbiter of poor behavior and makes OS/2 a high-reliability environment.

MULTIPLE VIRTUAL DOS MACHINES

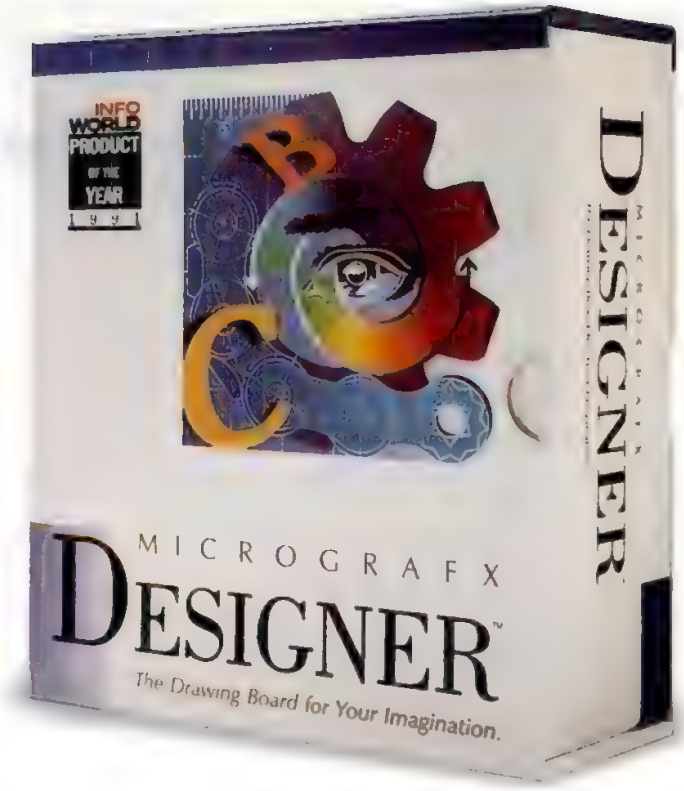
The Virtual Machine concept refers to the 80386's capability to emulate an 8086 chip and deliver all of the facilities in a manner that makes programs believe it really is an 8086. To this, OS/2 adds the Multiple Virtual DOS Machine (MVDM) service.

A DOS session on OS/2 doesn't talk to the machine hardware. Instead, it accesses all of the system resources by speaking to various "virtual" machines that pretend they are the component that the program was seeking. Through this method OS/2 is able to run many DOS sessions at once and use its built-in multitasking features to service each one.

The challenge to this approach occurs when a DOS program attempts to grab a physical device like a printer or the screen. The program is convinced that it has the machine to itself and has no capacity for dealing with resource contention. Chances are that you only have a single screen or printer available, and that may be in use by some other task. That's where Virtual Device Drivers (VDDs) step in.

VDDs are software tools that appear to the program as the physical device that it has requested. All VDDs are loaded at Ring 3 and can take advantage of multitasking services. Through this approach, a printer VDD, for example, can service print requests from numerous DOS applications and appear as a dedicated printer to each one. This eliminates resource contention and at the same time frees up a good deal of memory that can be used by DOS. According to IBM, a Virtual DOS Machine will have up to 633KB of memory available to it because the device drivers are loaded outside of the DOS space. In a network environment, where available memory is squeezed by things like network device drivers, the virtual concept of OS/2 comes into its own.

Taken together, the Workplace Shell, the System Object Model, Rings, and Multiple Virtual DOS Machines help to create a stable, hospitable environment for the development of new applications.



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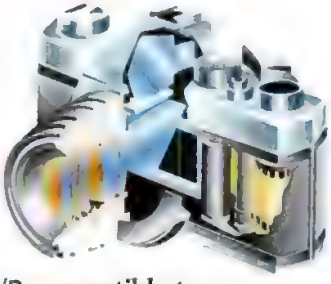

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The graphics engine is expected to be released this summer.

❖ IMPLEMENTS OF CONSTRUCTION

All the different types of tools—languages, code generators, design tools, editors, and databases—are now available within the OS/2 programming environment. So, anyone who wants to get started right away—either an in-house or a commercial developer—can find the proper tool to suit his or her needs. Says Jeffrey Tarter, Editor and Publisher of Softletter, " Development tools are good and getting stronger. The market seems to be doing very well."

At the forefront of the tools issue is the availability of language compilers for the 32-bit environment. IBM shipped a 32-bit C compiler with the OS/2 2.0 release to early positive reaction. IBM used the compiler to write many of the utilities that accompany the compiler. The utilities are included in the IBM Developers Toolkit for OS/2 (retail $119).

With regard to the "open" view of OS/2 that IBM is promoting, the Workframe product, IBM Workframe/2 ($90), provides an application development desktop for the programmer. Facilities on the desktop include the Compiler, the Editor, the Linker, the Make utility, the Debugger, and a project management facility. Users can mix and match from among their favorite tools. This open approach will allow developers to use their favorite Editor with their compiler of choice and to integrate all of these facilities into the Workframe environment.

❖ OTHER THIRD-PARTY TOOLS

Watcom, the Waterloo, Ontario, compiler developer, has announced that its 32-bit C compiler will be compatible with the Workframe environment. Watcom will also provide a 32-bit version of its popular Fortran-77 compiler. Zortech has also announced a 32-bit C compiler for the 2.0 platform.

As C++ becomes increasingly significant for corporate developers and ISVs alike, Borland has announced a new 32-bit C++ compiler for OS/2 2.0. The product was due to go to beta testing at the time of this writing, according to Alex Lane, Borland's product manager for OS/2 languages. For developers who are concerned about migrating existing C applications, Borland will comply with AT&T's CFRONT 3.0 specification.

Borland's C++ will ship with an Integrated Development Environment that features a Presentation Manager–hosted, macro-based, multifile editor with an integrated debugger. Borland also includes its new ObjectBrowser for examining functions, variables, and classes in C++. The Borland Resource Workshop is used to manage OS/2 resources from a single environment and, significantly, no Software Developer's Kit (SDK) is required. Says UCSB's Wallace, "C++ is the one that a lot of people are waiting for."

Later in 1992, Micro Focus Inc. will ship a 32-bit version of its popular COBOL compiler for OS/2 2.0. COBOL/2 Workbench for OS/2 2.0 will offer a complete development environment for COBOL developers, whether they are targeting the mainframe or the PC.

Doug Brown, divisional product manager at Micro Focus, cites the company's breadth of tools as a major factor in its success. "For the mainframe programmer we offer tools to help with file transfer, source code management, EBCDIC data support, data file editing, and Animator, our COBOL debugger."

Micro Focus also offers add-on products that allow the mainframe programmer to emulate CICS or IMS on the PC. This last point has proved to be a key consideration for many mainframe developers in selecting COBOL/2. Greg Buchanan, director of technology planning and development at Cincinnati Bell Information Systems, in Maitland, Florida, says, "We chose OS/2 because we wanted a better development environment, and with Micro Focus we were able to offload mainframe development cycles."

Enfin Corp., in San Diego, California, is making a version of its Enfin/2 product available for OS/2. Enfin/2 is an object-oriented application development environment based on the company's implementation of the OOP language, Smalltalk. "What differentiates our offering", says John Eyerly, vice president of sales and marketing, "is that we've built a very extensive class library so that developers already have the tools necessary to interface their OS/2 applications to SQL databases and host mainframes." Enfin/2 includes all of the GUI controls and a 4GL-type tool that lets the developer create applications with external data links without writing program code.

Gpf from Gpf Systems provides an interactive GUI development tool for building OS/2 applications. Gpf combines a design facility with a design interpreter and a code generator. Developers, faced with adding graphical front ends to existing applications, are impressed with how well the product provides for quick, easy layout and testing.

Gpf shortcuts the PM development process in several ways. First, there is no need to write any user-interface code; the user just designs the menus and dialog boxes and Gpf will generate all the code. Second, there is no need to go through the code-generation, compile, and link steps very often. Finally, there is much less bookkeeping and debugging to be done than if the code were written by hand.

The variety of available tools portends a rich application environment for OS/2, although that doesn't help users who want their software yesterday. While we're waiting, it helps to examine the precedent set by Windows: It was a full year after the introduction of Windows 3.0 before the environment hosted a considerable depth and breadth. Around that introduction, the most exciting applications available were development tools.

Says Wallace: "There is enough to get by today. But if OS/2 2.0 is successful, everybody will switch gears."◆

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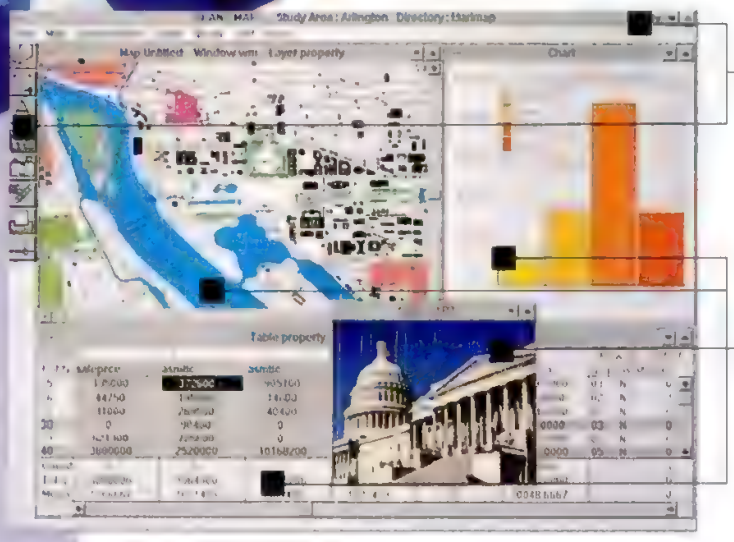

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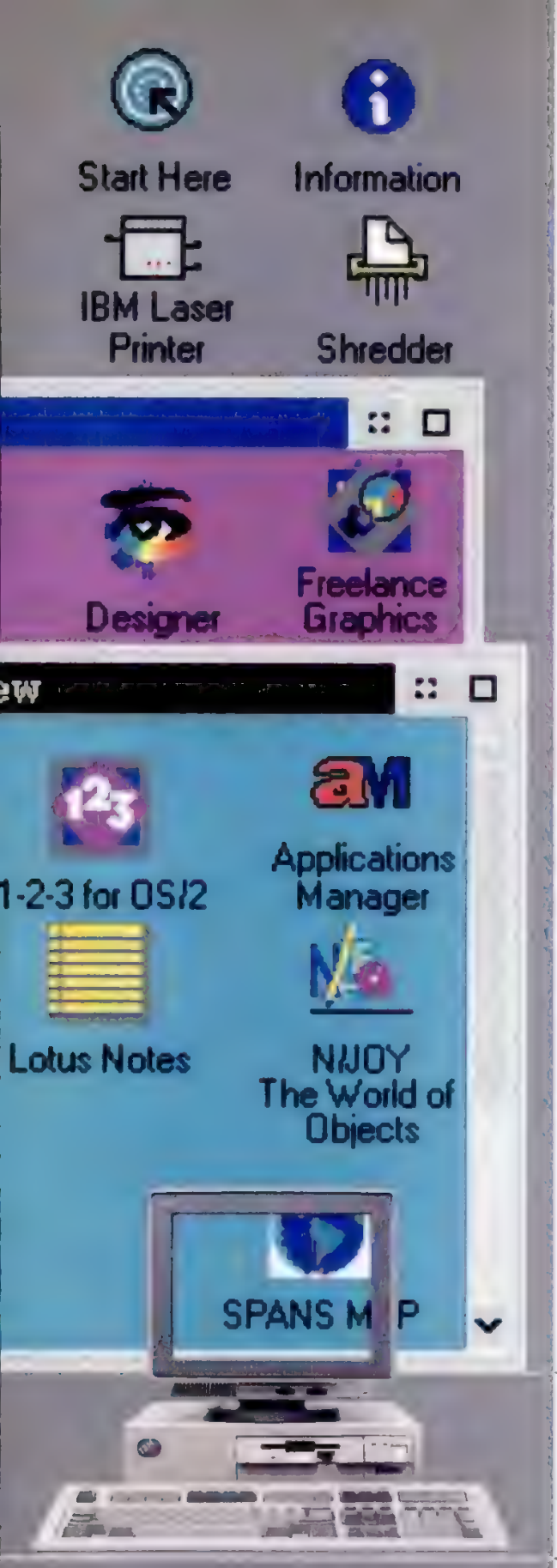

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OS/2 2.0's 32-bit operating system should give applications the memory and speed to do what would have been unthinkable—or at least dangerous—under DOS or Windows.

"It doesn't matter how much you try to stretch DOS, you still hit a wall," explains Don Babcock at Cajun Electric Power in Baton Rouge, Louisiana. "DOS is just exhausted." OS/2 2.0 is a solution precisely because it runs almost all DOS applications as well as most of those written for Microsoft Windows. At Cajun, the investment in existing applications runs between $250,000 and $500,000—an investment the electrical power cooperative can't walk away from.

Most important for Cajun and other corporate PC users is the fact that the all-encompassing nature of OS/2, encapsulated in the Workplace Shell desktop metaphor, makes for easy interoperability between various platforms. Users can cut and paste data from one application into another without having to jump through hoops, close down applications, and restart others—while keeping their fingers crossed that they won't have to reboot.

"Our customers are crying for choice; they don't want to be enslaved to one operating system and have to port over all their applications," explains Peter Muller, PM Draw product manager at Micrografx Inc., in Richardson, Texas. "They want to be in a 32-bit environment that talks easily to an IBM mainframe or a Digital Equipment Corp.[DEC] VAX."

Unlike the earliest versions of OS/2, which could run only one DOS application at a time, the new version of this 32-bit operating system has been designed to take advantage of the existing DOS and Windows application base. According to IBM's Personal Systems Division, more than 1,000 software developers are at work on 32-bit applications for OS/2 2.0. In addition, users can tap the existing mass of 17,000 DOS, 4,900 Windows, and 2,500 16-bit OS/2 applications.

What follows is a look at standard applications developed to extract the full benefit of OS/2 2.0, along with a look at how corporate users are harnessing OS/2 2.0 to their specific business needs.

❖ CORPORATE COMMUNICATIONS

When it comes to real-world corporate tasks, one of the most important is PC communications. Organizations depend on external links to data sources and wide area networks (WANs) and internal connections to the skyrocketing number of local area networks (LANs), and, in particular, client/server networks.

"Multitasking and OS/2's preemptive capability are critical for communications," states Marty Cawthorn, president of Cawthorn Software Group in Dearborn, Michigan. Cawthorn markets ChipChat, one of the few asynchronous communications programs written solely for OS/2. In the sometimes delicate world of communications, losing data characters across the line is lethal. If the operating system allows one application to halt another, then two or three characters could pile up, turning the data stream into garbage. Because OS/2 is a strong multitasking manager, that arbitrary halt never happens;

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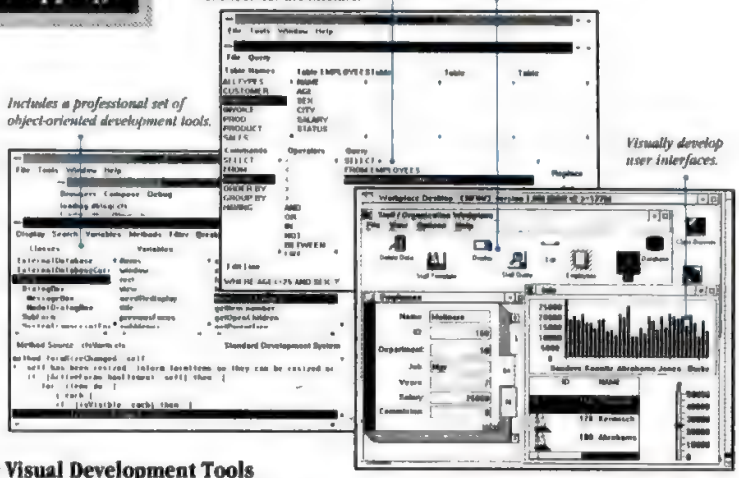

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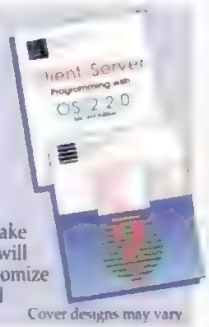

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OS/2 smartly determines which programs should run with what priority.

❖ NETWORK LINKS

Whether on PCs or mainframes, the old computing ways aren't working for many businesses. Users, suffering information overload, are looking for new tools that will provide them with better ways to do business.

For Cajun Electric Corp. last year, cc:Mail from Lotus Development Corp. was the final straw. Employees of the electricity generation and transmission cooperative in Baton Rouge, which serves 13 rural power companies in Louisiana, lost patience with the process. To send a message to the boss over Cajun's IBM Token-Ring local area network, employees found themselves tediously creating files, closing files, opening applications, closing applications, logging on to networks, logging off, accessing the mainframe, and signing off the mainframe—whether they were in any of the myriad DOS versions or in Microsoft Windows.

As a result, Cajun is beginning to migrate as many as 80 percent of its approximately 200 PC users to OS/2 2.0, reports Babcock, manager of user services in Cajun's information systems group. "If you're in communications to e-mail and hosts (computers), you've got to be able to quickly get the data off, assured that it's complete," he says. "OS/2 has given us the confidence to do that." Further, Cajun likes that most users will be on a common platform, thus decreasing training and giving everyone the common OS/2 Workplace Shell capabilities.

❖ CONNECTIVE TISSUE

One of the biggest computing challenges for today's organizations is to make available to decision makers the tons of data that pours in. The key is database management systems (DBMS), which begin to bring order and relevance to the information. Precisely because of the heavy processing and multitasking demands of database systems, DBMS providers, including Oracle Corp. and Microrim, were among the first to embrace OS/2, even in its 16-bit incarnation.

With the 32-bit speed of OS/2 2.0 and greater connectivity to other databases running on minicomputers and mainframes, PC-based databases are flying, and more users are being served simultaneously. "We're seeing significant increases in performance using Oracle Server for OS/2 2.0 over Version 1.0—as much as 100 percent in some situations," reports Alan Edmonds, MIS manager at Victoria Bankshares Inc. in Victoria, Texas. More good news: Victoria can postpone hardware expenditures because of the software improvements.

An increasingly popular approach to database management proposes to see the world through the eyes of the end user and to provide object-oriented systems to scan through DBMS files. OpenBooks from Open Book Software Inc. is one example of the new breed of tool—a sophisticated object-oriented query engine on the desktop, sometimes dubbed an "end user information system" (EUIS)—that may now blossom because of OS/2's power, user interface, and memory management. What counts is the information you have, not where it's stored, explains Kent Bradford, vice president at Open Book, in Cambridge, Massachusetts. By presenting business objects—forms, for example—on the desktop screen, programmers and/or departmental users can generate complex query strategies; stored on a large server, OpenBooks 1.13 can then access files on mainframes or other LANs, perhaps skimming as many as three different databases.

"That level of complexity requires a very large, complex piece of code on the PC," Bradford explains. OS/2 prevents applications using large amounts of

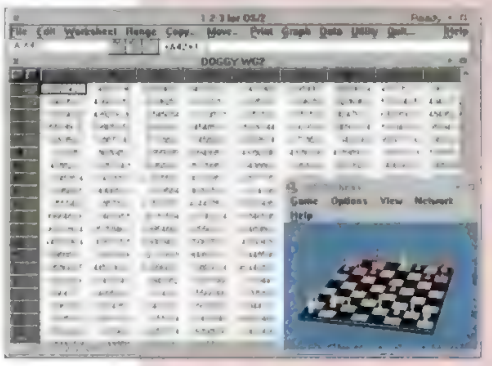
OS/2: PLAYING GAMES IS GOOD FOR YOU

When it comes to the games included on the OS/2 2.0 desktop, there's a serious purpose behind the fun.

"The games are there to train users to use the mouse and the title bars," says Larry Davis, an application development and technical troubleshooter for IBM's Personal Systems division in Austin, Texas. "It's a safe environment. Everyone knows how to play Solitaire. It's a test drive." Just as the OS/2 tutorial introduces users to the basic concepts of OS/2 2.0 while the software is installing, the games have their own training mission.

To sharpen multitasking skills, users can play the included chess game. Two users on the same local area network can begin a game, then shrink or minimize the chess window in order to work in other applications. The system notifies each player when an opponent has completed a move. In between moves, the inactive player keeps working.

If your day has been one disaster after another and you're desperate for something to go right, play Solitaire. There's always the cheat command—if you can find it!



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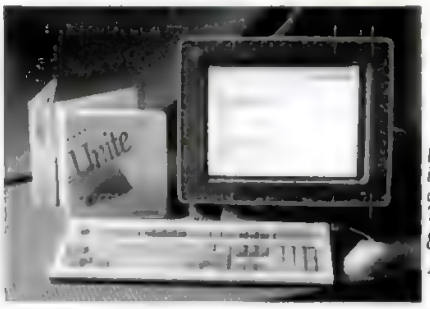

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memory on the PC from stepping on themselves when memory is full—a critical feature for data-intensive end user information systems.

❖ POWER LIFTERS

For user organizations as well as software and data suppliers who manage large amounts of data, such as Wall Street and insurance firms, OS/2's memory management, multitasking, security, souped-up speed, and enhanced input/output file processing make a huge difference in performance. These are the power-lifter products and projects, many conceived to run on a mainframe, but vastly more cost-effective on the PC.

The purpose of financial analysis software from SAS Institute is to access and manage huge amounts of data, a chore constrained by the memory limitations of DOS and Windows, explains Lynne Harris, a support analyst at SAS in Cary, North Carolina. "We tried various avenues to expand memory, but not until OS/2 did we find superior architecture," Harris says. SAS, the tenth-largest software company in the world, expects to introduce an OS/2 2.0 32-bit product by the first quarter of 1993.

Preemptive multitasking, which enables other tasks to run safely alongside the SAS analyses, and security guards within OS/2 are also critical to SAS users. "Users can't afford to have application code overwritten by other applications, or to have errors introduced," Harris says. Because of the gigantic size of many SAS applications, OS/2's high performance file system further optimizes multitasking and data throughput. "We've seen performance improvements of 25 to 30 percent in data pumping through the system," Harris adds.

❖ SERVER SAVVY

The growing importance of servers may prove to be one of the most compelling aspects of OS/2, suggests Cheryl Currid, a computing consultant who heads Currid and Co. in Houston. "OS/2 is a very nice environment," she says. "IBM has done a beautiful job. But the things that make OS/2 compelling may not be compelling enough for many workstation users. Currid suggests OS/2 may find its greatest use on LAN servers and its staunchest support from LAN administrators.

Data at the Missouri Highways and Transit Department is being transferred from mainframes at the state capitol in Jefferson City to the agency's ten district offices. Each district will soon have IBM PS/2s connected to IBM local area networks. While OS/2 may go on a few workstations, its stability and multitasking capabilities are critical for the servers in those district offices.

> USERS can't afford to have application code overwritten by other applications or to have errors introduced, says Lynn Harris of SAS Institute.

"People doing the [systems] administration have to have OS/2 to do that management," says Robert Hitt, who manages network servers for the agency's end user support group. OS/2 will also run on about 100 of the 600 PCs at the capitol, where users truly run multitasking applications, Hitt says.

One possible example is the road-quality tracking system. Missouri has an ambitious program in which a van is equipped with a video camera that films every foot of Missouri's 32,000 miles of highways and byways. Every 10 feet on the road, as recorded on the video, is notched, evaluated, and historically annotated on a PC system so that the agency can constantly evaluate road quality, rate various surfaces, or chart deterioration over time—information much needed for planning by the state and federal governments in tight fiscal times.

❖ INDUSTRY APPLICATIONS

Niche market software developers also see OS/2 in their future. From obscure applications that handle such behind-the-scenes tasks as delivering educational TV programming to hospital rooms to PC-based applications that carry the bulk of a business's operations and bookkeeping, OS/2 is being incorporated into standard systems.

Professionals such as psychologists and drug counselors want the convenience of portable computers for use on their patient visits, but they also want the ability to run interactive programs and to link their systems to insurance companies or other systems. OS/2 is necessary "to be able to do a lot of complex tasks and generate reports quickly," notes Patrick D. Pearce. OS/2 was the only operating system with multiple threads to handle sorting and printing when he founded Life Care Development Corp. two years ago.

Life Care, in Ossining, New York, zeros in on the drug-counseling health-care niche with Life Care Review, a $995 program for psychiatrists and counselors who need to track patients, treatments, and related information required by the numerous health-care system participants.

❖ GRAPHICS—ANY WAY YOU DRAW IT

The more memory and power, the easier and faster it is to redraw or reconfigure graphics and presentation programs. But the serendipitous benefit of OS/2 to large organizational users may be that "it allows people in the same office environment to work together," says Muller at Micrografx.

"Functionally, it really isn't going to change that much. What it will provide is cross compatibility against platforms," says Muller, product man-

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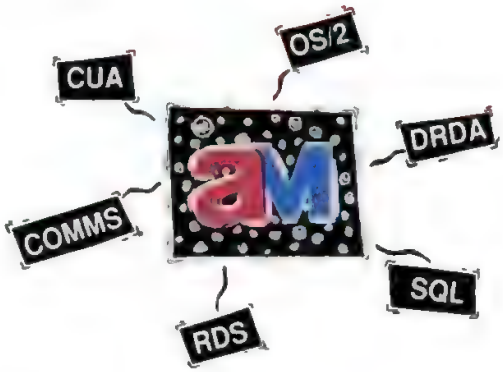

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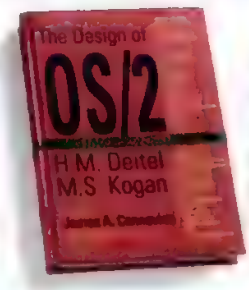

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OS/2 2.0 CERTIFIED

ager on Micrografx's Windows Draw, which will shortly be available as PM Draw for OS/2 2.0.

At the Royal Bank of Canada information systems group, CorelDRAW for OS/2 has caught on so well that staffers produce individual, by-name invitations to meetings. It is also a key tool for presenting ideas, from flow charts to space layouts to important slide presentations—presentations which once took days to produce but are now pulled together in a day, says Michael VanHumbeck, technical systems analyst at the bank's IS headquarters in Toronto.

❖ WORD PROCESSING

The first and one of the most powerful word processing programs for OS/2 is DeScribe 3.0 from DeScribe Inc. in Sacramento, California. OS/2's multitasking shines in processing lengthy documents or mail merges from 500-name lists. "It can take a long time to print letters if you're mailing to 500 or 600 people," says Merrylee Croslin at DeScribe. "If you're running OS/2, it's simply a matter of telling the system to minimize the window of the document it's running in." Then OS/2's multitasking takes over—even on a 25,000-page document with almost all the font sizes you can imagine. ◆

◆ OS/2 CASE STUDY ◆

MCI: Coping with the Relatives

Grandma and the aunts and uncles could have ruined MCI Communications' big marketing strategy last year. When MCI invited residential customers to save on long-distance calls by joining its Friends & Family program, the company had just implemented a massive new customer service system based on PC workstations. If the order and service system hadn't worked, if Friends & Family subscribers hadn't gotten connected to their relatives, or if Aunt Mabel had gotten billed incorrectly, MCI would have heard about it; and MCI's feisty competitors would have chimed in.

For the nation's second-largest long-distance phone company, which last year had revenues of $8.4 billion and a 16 percent increase in telecommunications traffic, the Friends & Family discount attracted 7 million subscribers, about 5 million of whom were new to MCI.

"It's been our most successful program," reports James Zucco, MCI's senior vice president of systems engineering. "But it put enormous additional requirements on our customer-service representatives. Not only did they need to know [information] about individual customers, they needed to know what members of their Friends & Family circle were doing."

Handling this customer surge was not easy. At about the same time MCI launched the Friends & Family promotion, the information systems group moved 3,500 customer-service representatives to a new one-stop customer-service system. In the new system, IBM Personal System/2 Model 90 workstations deliver data over IBM Token-Ring local area networks. A representative uses one workstation telephone to enter new orders, answer billing questions, consult listings on who signed up for Friends & Family, view correspondence to or from customers, and resolve service inquiries. Prior to this one-stop system, service representatives had to scramble between PCs, mainframe-connected terminals, paper reports, and voice calls.

Doing all work at one workstation has eliminated paper: All correspondence is now done electronically.

Making all these applications understandable to the telephone representatives is a simple, common PC interface—IBM's OS/2. "What we were able to do was integrate a number of applications, including some on mainframes, and put those on a single platform," explains Zucco.

"While the underlying technology was old-world mainframe based, OS/2 made it possible to layer New-World technologies—multitasking and graphical user interfaces—on top. The selection of OS/2 was driven by the need to provide a single environment. As many as four sessions may be on the OS/2 screen, with data input from LU 6.2 mainframe links, 3270 emulation, digitized image files, or server-stored records."

Thus, reps can have customers on the phone and discuss letters they have written, bills that have been sent, and other MCI data because it's all in front of them on one screen.

MCI also took advantage of new ISDN (Integrated Services Digital Network) telecommunications technology in building the customer-service system. Because of ISDN stored data, representatives immediately know the phone number and customer name at the location from where a customer call is made.

MCI's new one-call customer service is a competitive advantage application that business-school professors point to today when calling for organizations to reengineer their business processes: The goal is not just to automate old paper processes, but to rethink work flows and how work gets done.

IBM PROMISES TO PROVIDE BACKUP

The considerable bells and whistles of OS/2 2.0 won't be heard if users don't try it, or, worse yet, if they don't use more than the most basic functions. IBM, realizing human limitations, has launched an ambitious three-pronged campaign encouraging customer acceptance of the operating system on which IBM is betting its PC future.

IBM wants OS/2 2.0 to be:

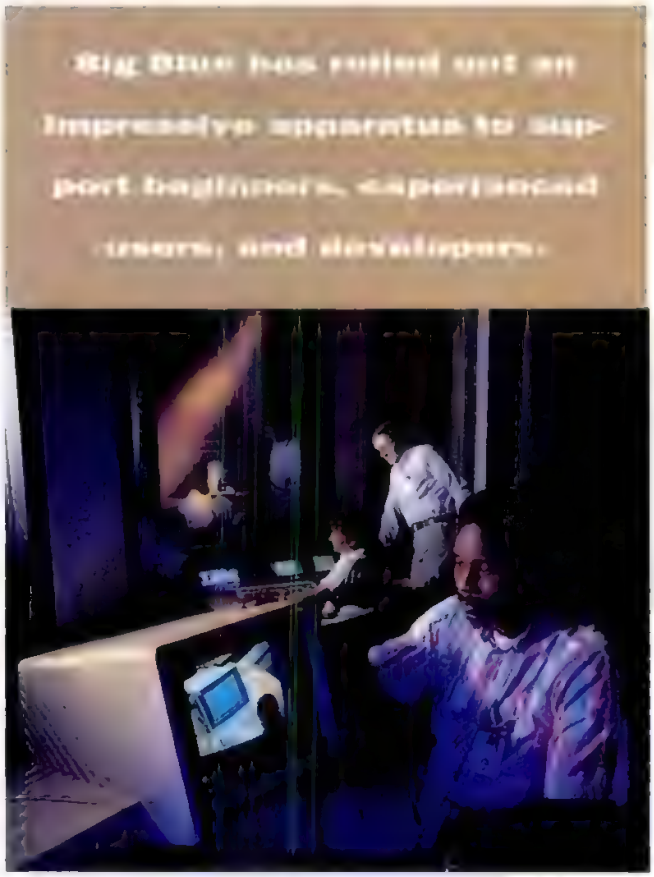
- **usable** (in human-factors design jargon), or simply, easy to learn and easy to use;
- **compatible**, so that the operating system software works flawlessly with the wide variety of hardware currently in use; and
- **thoroughly supported**, so that questions get answered and problems resolved for all users, from beginners to corporate accounts with OS/2 licenses to software developers big and small.

In Boca Raton, Florida, home of the original IBM PC, IBM has a brand-new usability lab, a growing hardware compatibility lab, and a beefed up customer service force (which includes locations outside the Boca Raton division headquarters).

❖ USABILITY STRATEGY

What works? What doesn't work? These are never easy questions, and they prove especially tough when developing a 32-bit operating system that needs to serve the gamut of users, from the novice to the mainframe programmer to the power PC user. IBM responded by building a human-factors laboratory to evaluate its software, particularly user interfaces, and by implementing an ongoing process to test and tune designs. The process of human-factors testing involves nonbiased evaluations. A third-party agency recruits test participants ranging from the 60-year-old shipping-dock clerk to the hotshot PC programmer. These testers, as many as 16 at once, try segments of just-developed programming code to determine how usable it is. That usability is based on a variety of considerations, including the time to complete the task, variations of times between novice and experienced users, number of errors, and number of participants who actually complete the task.

None of this information and observation, however, results in changes until it is accepted by the developers of the code. "Nobody wants to hear, 'Your baby is ugly,'" comments James A. Hunt, who manages the Boca Raton usability lab as manager of system usability at the Personal Systems Programming Center. These tests provide a powerful, if at times painful, reality check for how the software fares with actual users.



At its usability labs in Boca Raton, IBM can discover the probems users have with software before it ships into the highly competitive marketplace.

PHOTOGRAPHS BY BRIAN SMITH

❖ ROLL THE VIDEOTAPE

The testing facility resembles an unlikely hybrid of a tiered surgery amphitheater and a high-tech focus-group meeting room. The lab is staffed by a mix of expert professionals trained in human factors and psychology, many of whom have specialized in various parts of software design, such as graphical interfaces.

To capture and annotate tests for future reference, members of the lab staff monitor a subject's progress at regular intervals via their own control panel–like sys-

tem. The system records the data in a lab database and keys it to a video tape recording of the entire session. The tester can view his entries on a second computer screen, with the other two screens showing video broadcasts of the individual's action, while an inner office screen shows the program being used.

IBM shocked a number of manufacturers when it asked them to submit machines that could be used to test the compatibility of their equipment with OS/2 2.0.

❖ REVELATION POINT

When programmers can't attend the testing, the sophisticated database and video link make it possible for Hunt and staffers to excerpt portions of the test, say, ten instances of a commonly made error. Then, they can edit 20-second demonstrations of that repeated error into a short, persuasive video of the problem. Presto, developers see the light. While programmers are unwilling to view hours of video tapes, they're quickly convinced by the filmed record of repeated errors.

The videotaping, video database, and usability lab itself can provide reports within 1 or 2 days, compared with tracking behavior manually and then taking 2 to 4 weeks to prepare reports. Programmers are much more willing to make changes on code they've just written, and are perhaps still working on, than in completed work from months ago, says Hunt.

In the top tier of the usability lab is a one-way glass-encased circular room equipped with video screens to monitor the testing offices below it. Here, developers who aren't convinced by videos or written reports can actually watch their software being used.

Although the bulk of the testing on OS/2 2.0 was completed in the past year, human-factors testing is ongoing as IBM plans upgrades and new versions that will continue to make the operating system easier to use, or will add features.

The usability lab is just one major effort within IBM to create the best operating system. IBM believes that about 30,000 users tried beta versions of OS/2 2.0 and sent 90,000 messages on various electronic forums and bulletin boards, including CompuServe, MCI Mail, and IBM's own internal mail system.

❖ COMPATIBILITY LAB

Admittedly, other PC manufacturers were skeptical last year when IBM's Personal Systems Division requested machines to use in testing. "We're in the software business," countered Glenn M. Christensen, who manages the OEM compatibility lab in Boca Raton. Now, manufacturers line up to get IBM's seal of approval that their systems run OS/2 2.0. So far 195 (including all the expected big manufacturers) have cleared the OS/2 2.0 bar, and more are in the wings, primarily laptops, 80486 systems, and systems designed as LAN servers.

Both sides—IBM and the hardware manufacturers—want to ensure users painless processing, which is frequently a matter of assuring that the hardware and software don't step on the other's toes. Both benefit when users get the fastest performance possible.

To handle this testing surge and the huge shipping, receiving, and set up process, the lab has grown from 3,000 square feet to 10,000 square feet. A similar OEM test lab in Basingstoke, United Kingdom, is handling European manufactured systems, which speeds up the testing worldwide.

❖ OPERATORS ARE STANDING BY...

When it comes to answering customers' questions about OS/2 2.0, it seems that IBM wants no question to go unanswered. "Nobody gets left out in the cold," assures Hayward Rigsby, who answers software developers' questions from Boca Raton. Depending on what hats they wear, users may find themselves with several 800 numbers to call or locations to contact.

The company is also offering 60-day support free with the shrink-wrapped package. New purchasers who want to talk to a friendly voice can call 800-237-5511 for questions about installation or use or to download productivity aids. Normally, this support would be $129 a year. For your modem, there's the OS/2 2.0 services bulletin board at 800-547-1283—and IBMers are conscientious about responding to questions that haven't been asked previously.

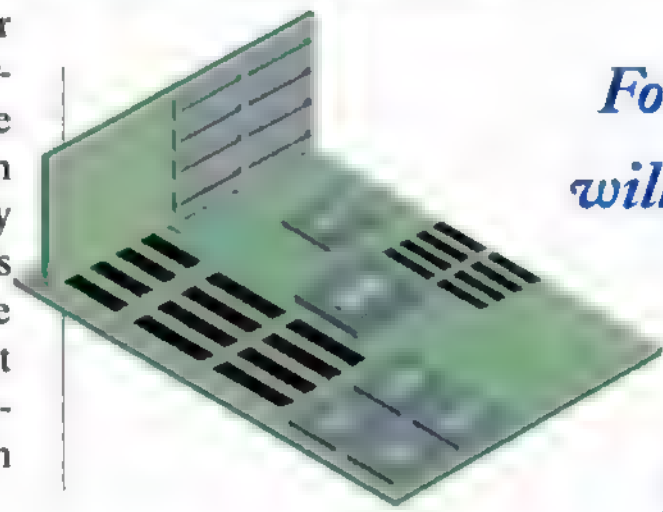
IBM has established a complex internal hierarchy to answer questions from developers. Besides Boca Raton, answers come from Austin, Texas, and other specialized IBM locations. If organizations want added hand-holding or anticipate big, big problems, there's SystemXtra (800-426-9872), which IBM calls a "premier level of software service and support." ◆

OUR CONTRIBUTORS: Posy Gering owns pg ink, a Seattle-based consulting group that specializes in writing business and technical materials. **Charlie Bermant** is a free-lance writer living in Gladstone, OR. He is the co-author of the current "101 Windows Tips + Tricks" (Peachpit Press) and the upcoming "Hot Links" (Osborne-McGraw Hill). **Bob Pinkerton** is the President of Pragmatix, a Bellevue, WA–based consulting firm .

tures are the major distinguishing characteristics of BIOSes. Most BIOSes are compatible with most software, but when you venture into more exotic realms, such as networking, you may find some problems. For the most part, you cannot select your BIOS: You are left to depend on the motherboard maker's judgment. But a few companies offer replacement BIOSes so you can change what's inside your PC if you encounter incompatibilities.

EXPANSION SLOTS

PCs are made to be expanded, and with today's surge in new operating system development, you will be tempted to add memory, peripherals, and even a faster processor to your system. Four motherboard features determine this potential growth: the number and type of expansion slots, the number of memory sockets, the type of SIMMs the system accepts, and the presence of an upgrade socket for a more powerful microprocessor (if you have invested in an Intel 486-based system).



Peripherals whose basic controls are not built-in require separate cards that fit into expansion slots on the motherboard. Though 386-based systems typically leave you with one main decision (namely, how many slots you need), shopping for a 486 requires you to consider some other factors, such as I/O architecture. The original AT bus, ISA (Industry Standard Architecture), provides a 16-bit path for data to travel from one component to the next. You can also choose a 32-bit bus, *EISA* (Extended Industry Standard Architecture) or *MCA* (Micro Channel architecture).

Traditional wisdom holds that the future belongs to the advanced, 32-bit expansion buses: EISA and MCA. Each has its merits—particularly in the file server market—but both have been slow to reach the mainstream. EISA systems will make up about 9 percent of the market and MCA about 19 percent by the end of 1992, according to International Data Corp. By 1993, those figures should increase to 17 and 21 percent, respectively.

Some motherboard makers, on the other hand, report a surge in interest in 16-bit ISA slots and a decline in the newer buses. EISA is plagued by a complex, unforgiving installation procedure. Many people cannot discern any performance advantages to the MCA bus. MCA motherboards also do not accept standard ISA cards. For these reasons, the bus appeals most often to IBM shops.

Moreover, few peripherals take advantage of the greater performance potential of these advanced buses. For standard desktop applications, therefore, you will probably be safe if you stick with the ISA bus. But if you are shopping for a high-speed file server that runs a 32-bit network operating system, such as NetWare 3.11, you might consider a 32-bit I/O bus—particularly as its price premium decreases.

For standard desktop applications, you will probably be safe if you stick with the ISA bus, because few peripherals take advantage of the greater performance of EISA and MCA.

Recently, the PC industry had pinned its high-speed expansion hopes on a new concept: the *local bus*. Ostensibly a video expansion slot, the local bus provides a microprocessor-speed extension for connecting peripherals. Local bus will supplement rather than replace ISA; in effect, computers that use this design will have two expansion buses—an ISA bus for compatibility with old cards and a local bus for high performance peripherals. Currently, most local-bus development is occurring in the video field.

No single standard has emerged for this technology yet: OPTi has one implementation, the Video Electronics Standards Association (VESA) is hammering out a plan, and Intel has promised its own version. The OPTi implementation is a true local bus, an extension of the 486 microprocessor that allows the CPU to address video and other peripherals at full clock speed and 32-bit bus width. The VESA implementation is a high-speed, arbitrated expansion bus with many of the features of EISA and the speed and bus width of the OPTi design. Like the other two implementations, Intel's PCI (peripheral component interconnection) will allow video data to be sent at the CPU's speed instead of the 8-MHz I/O bus speed.

The electrical designs of the OPTi and VESA local-bus implementations are incompatible and will require different expansion boards. But system boards based on either design will accommodate ISA boards as well as local-bus cards. Due to the high speed of the local bus (50 MHz on a 486/50-based system, for example), motherboards are limited to only three local-bus slots.

Although the technology is still in its early stages, PC Labs has found that local-bus video can outperform standard VGA, accelerated, and coprocessed video. Chips & Technologies' new Wingine motherboard, with its own proprietary local-bus video implementation, performed nearly four times as well as a standard VGA card on PC Labs' Windows graphics test suite, but the Wingine's performance was only about 20 percent better than that of a coprocessed video card.

MAXING OUT MEMORY

Because today's software applications require large amounts of memory—and because operating environments such as OS/2 2.0 and Windows 3.1 allow you to run several apps at once, you will want a system with decent memory expansion—and therefore, easy access to memory sockets.

Any modern system board will use *SIMMs* (single in-line memory modules) for memory. Loose DIPs (dual in-line package chips) take up too much room, and other types, such as single in-line pin package (SIP) and zigzag in-line pin package (ZIP or ZIPP) chips, are rarely seen. SIMMs come in a variety of sizes, from 256K to 16MB. Currently, 1MB and 4MB SIMMs appear to be the most popular, selling for as little as $40 per megabyte.

Service and Reliability

8,592 *PC Magazine* subscribers rated 34 vendors for reliability, service, and support, along with whether they would buy again from the same vendor.

The 1992 *PC Magazine* Service and Reliability Survey was published in our May 26, 1992, issue. For your convenience, we've summarized the numerical results in the accompanying tables.

The results are based on 17,000 questionnaires sent to randomly chosen *PC Magazine* subscribers. We received 8,592 replies—a 51 percent response rate (excluding 125 undelivered surveys).

An average score was calculated for each manufacturer, based on responses reported on a scale of 1 (the lowest rating) to 10 (the highest rating). As with any sample survey reporting average ratings, there is a margin of error associated with each score. Therefore, small differences in ratings may not be significant. For more details, see our May 26 issue

The 1992 PC Magazine Service and Reliability Survey

Desktop PCs

Overall PC reliability		Future likelihood of buying from the vendor		Satisfaction with repair service		Satisfaction with technical support	
Gateway 2000	9.13	Gateway 2000	9.02	Zeos International Ltd	8.82	Northgate Computer Systems	8.82
Zeos International Ltd.	9.08	Zeos International Ltd	8.58	Gateway 2000	8.73	Swan Technologies	8.69
Swan Technologies	8.95	Northgate Computer Systems	8.06	Northgate Computer Systems	8.69	Dell Computer Corp.	8.67
Hewlett-Packard Co	8.87	Swan Technologies	7.98	Dell Computer Corp	8.53	Zeos International Ltd	8.50
AST Research	8.77	Austin Computer Systems	7.91	Austin Computer Systems	8.44	Gateway 2000	8.44
Dell Computer Corp.	8.77	Dell Computer Corp	7.77	CompuAdd Computer Corp	8.42	CompuAdd Computer Corp	8.25
Compaq Computer Corp.	8.75	CompuAdd Computer Corp	7.65	Swan Technologies	8.38	Digital Equipment Corp	8.00
Northgate Computer Systems	8.75	Toshiba America Information Systems	7.34	Hewlett-Packard Co.	8.33	Everex Systems	8.00
CompuAdd Computer Corp	8.74	AST Research	7.33	AST Research	8.21	Hewlett-Packard Co	7.95
IBM Corp.	8.74	DTK Computer	7.28	DTK Computer	8.20	Austin Computer Systems	7.93
Toshiba America Information Systems	8.74	Everex Systems	7.17	Everex Systems	8.16	AST Research	7.78
Austin Computer Systems	8.65	Packard Bell Electronics	7.05	IBM Corp	8.10	DTK Computer	7.58
Apple/Macintosh	8.59	Apple/Macintosh	7.00	Unisys Corp	8.10	IBM Corp	7.48
Everex Systems	8.59	Advanced Logic Research	6.77	Acer America Corp	8.09	Toshiba America Information Systems	7.46
NCR Corp	8.58	Hewlett-Packard Co	6.76	Toshiba America Information Systems	8.02	NCR Corp	7.45
Packard Bell Electronics	8.57	Acer America Corp.	6.72	NCR Corp.	8.01	Acer America Corp.	7.43
Tandy Corp /GRiD Systems Corp	8.56	PC Brand	6.62	Apple/Macintosh	7.99	Unisys Corp	7.35
DTK Computer	8.55	NEC Technologies	6.54	PC Brand	7.94	Epson America	7.31
NEC Technologies	8.55	Compaq Computer Corp	6.43	Compaq Computer Corp	7.93	PC Brand	7.26
Unisys Corp.	8.55	Epson America	6.18	Digital Equipment Corp.	7.91	Tandon Corp.	7.26
Epson America	8.52	NCR Corp	6.17	NEC Technologies	7.91	Apple/Macintosh	7.25
Acer America Corp	8.49	IBM Corp	5.90	Packard Bell Electronics	7.76	Memorex Telex Corp.	7.23
Advanced Logic Research	8.48	Hyundai Electronics America	5.75	Epson America	7.75	Compaq Computer Corp	7.22
PC Brand	8.48	Texas Instruments	5.29	Texas Instruments	7.69	Advanced Logic Research	7.18
Hyundai Electronics America	8.43	Tandy Corp /GRiD Systems Corp	5.17	Advanced Logic Research	7.63	NEC Technologies	7.18
Texas Instruments	8.33	Leading Edge Products	5.14	Zenith Data Systems	7.49	Texas Instruments	7.16
Leading Edge Products	8.32	Zenith Data Systems	5.07	Tandy Corp /GRiD Systems Corp	7.48	Hyundai Electronics America	6.98
AT&T Computer Systems	8.21	Memorex Telex Corp	5.02	AT&T Computer Systems	7.38	Zenith Data Systems	6.97
Zenith Data Systems	8.18	Digital Equipment Corp.	4.99	Wang Laboratories	7.37	Tandy Corp./GRiD Systems Corp.	6.92
Digital Equipment Corp	8.17	Tandon Corp	4.97	Memorex Telex Corp	7.28	Packard Bell Electronics	6.88
Wyse Technology	7.99	Unisys Corp	4.92	Wyse Technology	7.28	Wang Laboratories	6.70
Wang Laboratories	7.91	Wyse Technology	4.71	Hyundai Electronics America	7.27	Wyse Technology	6.64
Memorex Telex Corp	7.81	AT&T Computer Systems	4.61	Leading Edge Products	7.25	AT&T Computer Systems	6.45
Tandon Corp	7.58	Wang Laboratories	4.39	Tandon Corp	7.14	Leading Edge Products	5.88
Average	8.51	Average	6.42	Average	7.93	Average	7.48

Laptops and notebooks

Overall PC reliability		Future likelihood of buying from the vendor		Satisfaction with repair service		Satisfaction with technical support	
Zeos International Ltd	9.18	Dell Computer Corp	8.53	Dell Computer Corp.	8.89	Dell Computer Corp	9.12
AST Research	8.91	AST Research	8.33	Zeos International Ltd.	8.57	Zeos International Ltd.	8.66
Toshiba America Information Systems	8.81	Zeos International Ltd	8.28	AST Research	8.26	AST Research	8.06
Dell Computer Corp.	8.80	Toshiba America Information Systems	7.65	Compaq Computer Corp.	7.94	Compaq Computer Corp.	7.79
Compaq Computer Corp	8.74	CompuAdd Computer Corp	7.44	IBM Corp	7.83	CompuAdd Computer Corp.	7.67
Tandy Corp /GRiD Systems Corp.	8.67	Compaq Computer Corp	7.18	Toshiba America Information Systems	7.65	Toshiba America Information Systems	7.63
Texas Instruments	8.63	Texas Instruments	6.75	CompuAdd Computer Corp.	7.50	IBM Corp.	7.61
IBM Corp.	8.57	Sharp Electronics	6.63	Bondwell Industrial Co	7.43	Bondwell	7.41
Bondwell Industrial Co	8.51	Bondwell Industrial Co	6.60	Tandy Corp /GRiD Systems Corp	7.32	Tandy Corp /GRiD Systems Corp	7.33
Epson America	8.46	IBM Corp	6.11	NEC Technologies	7.27	Epson America	7.06
CompuAdd Computer Corp.	8.45	Tandy Corp /GRiD Systems Corp.	5.98	Sharp Electronics	7.15	NEC Technologies	7.00
NEC Technologies	8.28	NEC Technologies	5.81	Texas Instruments	6.93	Texas Instruments	6.72
Sharp Electronics	8.26	Epson America	5.48	Zenith Data Systems	6.78	Zenith Data Systems	6.70
Zenith Data Systems	7.97	Zenith Data Systems	5.40	Epson America	6.69	Sharp Electronics	6.53
Average	8.59	Average	6.87	Average	7.59	Average	7.52

Scale=1 (lowest rating) to 10 (highest rating)

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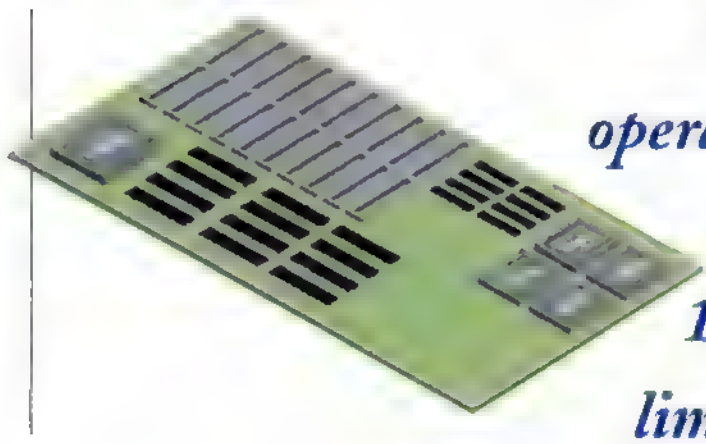
CIRCLE 107 ON READER SERVICE CARD

Your motherboard should be equipped with an adequate number of sockets and matching addressability to handle the needs of your software. (Note that metal SIMM sockets are preferable to plastic ones.) To take advantage of a 32-bit operating system such as OS/2 2.0 or Windows NT (when it ships), you will want at least 8MB of RAM, so a 16MB motherboard may prove limiting in the next couple of years. Many current products allow you to install 32MB, 64MB, or even 128MB of RAM.

Some motherboards require a proprietary *memory expansion board*, though such boards generally accept standard SIMMs. Although card-based memory can operate just as quickly as motherboard memory, you should consider getting whatever proprietary memory boards you might possibly need—even if they lack installed RAM—when you buy the system itself.



To take advantage of a 32-bit operating system such as OS/2 2.0, you will want at least 8MB, so a 16MB motherboard may prove limiting in the next couple of years.

CONSIDERING SIMMs

SIMM type is also important in considering motherboard memory. Several SIMM varieties are available, but the most popular 1MB SIMMs contain nine 1-megabit chips and are known as 1-by-9 SIMMs; 4MB SIMMs typically contain nine 4-megabit chips. In either case, the chips can be page-mode or linear. You will need four matching 1-by-9 SIMMs for each 32-bit memory bank (only two for a 386SX system). A few motherboards use IBM-style 36-bit SIMMs, which allow you to expand memory one SIMM at a time. This can be more convenient if your cash flow is tight, but you cannot mix and match these SIMMs with 1-by-9s.

SIMMs can also have different speed ratings, typically 60 or 80 nanoseconds (one-billionths of a second). The faster SIMMs are more expensive. In theory, quicker memory should benefit the performance of the system, but lab testing has associated no performance advantage in using 60-ns memory instead of 80-ns memory on current systems. Your best bet is to buy what the manufacturer recommends.

UPGRADABILITY

With 486 systems today, direct microprocessor replacements such as Intel's OverDrive clock-doubling chips add extra life and speed to your PC. You just add a new chip or replace your old microprocessor. If having this potential is important to you, then you will need a motherboard with a socket that accepts the OverDrive chip.

More than 90 percent of all 486 machines can be upgraded, according to Intel. The newer systems contain a dedicated *OverDrive socket* for the 169-pin equivalent of the 486DX2 (the OverDrive socket was briefly known as the performance enhancement socket). Weitek coprocessor sockets will not work because they are a different size, with 142 pins instead of the 169 required by the OverDrive. If you bought a 486 system before Intel announced its upgradability strategy, you will be able to replace your CPU with a 168-pin version of the OverDrive chip that will fit in the standard 486 socket and is scheduled to ship later in the year.

If you want to take advantage of this upgrade strategy in the future, be sure your prospective PC or its motherboard has a socket that is readily accessible. A CPU replacement for a system without the 169-pin OverDrive socket will be more convenient if you buy a system whose CPU sits in a *zero-insertion force* (ZIF) socket. This socket contains a lever that makes the CPU easy to lift out; getting the CPU out of a standard socket requires a chip puller.

CASE STANDARDS

The PC's case is both functional and decorative. While the latter attribute may mold most people's thoughts about the quality and desirability of the PC, the former really determines the machine's value. The functionality of a case determines the number of storage devices you can install, the type of motherboard you can install, and the position the computer takes on or under your desk.

The case serves as a chassis that holds everything together. Case designs have become standardized, patterned after the original IBM PC and its successor, the AT. The one advantage of standardization is interchangeability between parts. Choose an *AT-style case* (6 by 21 by 16.5 inches, HWD), and you will have the widest choice among power supplies and motherboards. *Mini-AT* cases (6 by 19 by 16.5 inches) maintain AT height to accommodate taller expansion boards. Both of these cases can accommodate two storage devices side by side.

These systems often leave room for three or four storage devices that you can reach from the outside of the case and at least one or two internal devices. In such a case, you can install both 1.2MB and 1.44MB floppy disk drives (still a must for many users), a CD-ROM drive, or a tape backup drive. (Even IBM discovered that the 5.25-inch bay is still mandatory for multimedia machines to host internal CD-ROM players.)

Some major PC makers have developed their own stylish cases of smaller dimensions. *Small-footprint* PCs measure 6 by 16 by 16 inches or less; *slimline* (or low-profile) systems have the same small footprint but are about 4 inches high. Slimlines require adapter cards to be placed in the case horizontally, with a T-bar attached to the motherboard. Both systems also may have room for as few as three storage devices.

Although the non-standard dimensions of small-footprint and slimline cases may complicate finding replacement parts such as standard power supplies, such systems benefit from the availability of space-saving devices. Examples of space-saving devices include two-in-one floppy disk drives, which accept both 1.2MB and

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1.44MB floppy disks in a single half-height unit, and 3.5-inch hard disks that hold 500MB of data or more.

Tower-style cases (24 by 6 by 17 inches) can increase your expansion options, providing more space for drive bays. These cases are essential if you are shopping for a large file server. Most aftermarket towers use standard power supplies and other components, and they can often hold from eight to ten half-height 5.25-inch storage devices.

A rigid box prevents circuit boards from flexing and mechanical parts from rattling loose. Choosing a strict AT-clone case will give you access to low-cost replacement parts (including power supplies and system boards). Proprietary designs, however, are often appealing choices because they provide more drive installation options or more convenient packages.

POWER SUPPLIES

Power supplies convert the utility-supplied AC electricity to the direct current used by your PCs logic circuits. PCs use four voltages: 5 volts for most of the logic circuitry; 12 volts for drive motors; and –5 and –12 volts for a few special circuits such as RS-232 serial ports.

Power supplies are standardized in two physical sizes: one to fit a full-size AT chassis and one to fit a mini-AT case. Some cases—principally towers and small footprints—use specially-matched power supplies. The disadvantage of these is service cost. A generic-size power supply will cost as little as $30, whereas a computer maker may charge $250.

The amount of power you need depends both on how far you plan to expand your system and on the system itself. Whereas 63.5 watts was inadequate for the original PC, it might prove sufficient for a machine today. After all, laptops get along with a fraction of that amount. Modern circuits need surprisingly little power. For example, a 50-MHz 486DX draws no more than 5 watts; most full-size expansion boards and modern hard disks draw less than 10 watts. Unless you plan to add several large storage devices, the 150- or 200-watt power supplies built into most PCs and aftermarket cases are generous.

Most power supplies include a fan that not only cools the heat sinks inside the power supply but also circulates the air to cool your PC. A higher capacity fan will move more air and offer more potential cooling. The power supply fan, the noisiest part, makes some PCs as loud as badly tuned vacuum cleaners.

Besides output power, input can be important if you wander beyond U.S. territorial limits. Most power supplies use a *slide switch* to accommodate both U.S.-style 117-volt power and the 230 volts used throughout most of Europe. Setting this switch improperly can lead to a service call. *Autoranging* power supplies, which adjust themselves to the voltage they receive, let you plug in without problem almost anywhere. If you travel, you will want an autoranging supply. You will also need a replacement power cable to match the different outlet standards used elsewhere in the world.

Once the motherboard, case, and power supply are in place, you can go about installing the components that make your computer the truly personal device it was meant to be. □

Mass Storage

Hard and Floppy Disk Options

Your choices in mass storage are wider than ever—particularly if you consider the media available today. Beyond hard disks and floppy disks, you can choose CD-ROM, magneto-optical devices, Bernoulli Boxes, or tape backup systems. But for business computing, the basics remain the same: A generous hard disk and two floppy disk drives will provide you with the storage and flexibility you need.

Finding the best hard disk is easier than ever. Unless you're buying a network file server or planning to install half a dozen different types of drives, today's best buying advice is rather radical: Buy your next hard disk—whether included in a personal computer or as an upgrade or replacement—by capacity, and add a disk cache. With the ascent of Microsoft Windows and OS/2 2.0, you should never consider a system with less than 100MB of storage. If you want to avoid "Disk Full" error messages for another year, opt for 200MB. The best strategy is to buy more than you think you need to forestall coming up short. (If you still run out of room, consider an on-the-fly data-compression package like Stac Electronics' Stacker.)

The hard disk subsystem connects to the motherboard using one of three interfaces: ESDI, IDE, or SCSI. ESDI (enhanced small device interface) and SCSI (small computer system interface) disks always require separate adapters; IDE's (integrated drive electronics) control circuitry is often built into the disk and the motherboard.

The real key to performance, though, is neither interface nor drive, but the cache you use—either on the controller itself (a hardware cache) or installed in system RAM (a software cache). Regardless of the interface, adding a cache can increase throughput by as much as 20 times.

Certainly all drive models in a given capacity range are not the same, but they're close enough for you to get on with your work. We'll make one exception: Be wary of the promises made for SCSI connections, not because of performance (it's generally somewhat better than ESDI or IDE), but because even experts may be challenged to untangle a SCSI chain. The most cost-effective hard disk you can add to your PC is an IDE hard disk coupled with a software disk cache. For the desktop and typical DOS and Windows applications, there's simply no reason to bother with anything else—even an advanced expansion bus like EISA.

FORGET SPEED

After all these years of worrying about what's inside a hard disk, counting the milliseconds in average access time, and weighing the advantage of one interface over another, advice like "Forget speed" sounds worse than heresy. Actually, it

shows the maturation of the hard disk industry. All the second-rate technologies and products—even manufacturers—have virtually disappeared. Most new hard disks, for instance, use servo voice-coil head actuators for excellent performance, have some park-and-lock mechanisms to prevent disk damage when they're switched off, and use hard sputtered (plated) media that make them insensitive to head crashes. In addition, MTBF (mean time between failure) ratings, once 5,000 to 10,000 hours, now can range from 100,000 to 160,000 hours. That's 11 to 18 years.

With new hard disks, size and power are not issues, either. A computer's drive bays come in two widths (3.5-inch and 5.25-inch) and three heights (3.2-inch full-height, 1.6-inch half-height, and 1-inch one-third height). Even if your computer has only one 5.25-inch drive bay and the rest are 3.5-inch bays, you'll still be able to install a 1.2MB floppy disk drive and have room for a high-capacity hard disk. Even 540MB hard disks that fit an inch-high, 3.5-inch drive bay are now available. Bigger disks (up to about 1.2 gigabytes) will fit in a standard half-height bay. Smaller 2.5- and 1.8-inch hard disks are becoming available for notebook computers, but their compact size and low power consumption don't buy you anything except the need for esoteric adapters to put them into a desktop PC.

With IDE and SCSI, too, you can get about as much capacity as you need: half-gigabyte IDE hard disks are readily available (including the 510MB Conner Summit CP-3544, 535MB Maxtor LXT-535A, and 525MB Seagate ST3600A), and dozens of SCSI disks handle more than a gigabyte of data.

WHAT MATTERS MOST? CACHE.

To determine the merits of the different I/O buses, caches, and disk interfaces, we tested three 340MB hard disks (IDE, ESDI, and SCSI) on our AMI 486DX/33 EISA and ISA motherboard test-beds, using different controllers and caches: a Micropolis Model 1564 with EISA and ISA controllers from UltraStor (ESDI), a Micropolis Model 1684 with EISA and ISA controllers from Distributed Processor Technology (SCSI), and a Maxtor LXT340A with a Silicon Valley adapter for EISA only (IDE). Our ISA motherboard had built-in IDE support.

Though the caching hard disk controllers improved performance under our DOS-based benchmark tests, adding SMARTDrive 4.0, the version that comes free with Windows 3.1, had far greater impact. Note that Windows 3.1 uses SMARTDrive 4.0 (SMARTDRV.EXE), a substantial improvement over the earlier SMARTDRV.SYS found in DOS 5.0 and Windows 3.0. Commercial disk-caching programs such as Multisoft Corp.'s Super PC-Kwik or the shareware cache HyperDisk from Hyperware also accelerate hard disk performance.

Cache makes raw disk performance irrelevant. Adding a hardware cache (memory built into the disk controller or host adapter) produced a dramatic improvement on PC Magazine Labs' tests—a 30 percent to 380 percent increase over uncached performance, depending on the disk interface and expansion bus design. The SCSI interface benefited most from hardware caching; ESDI the least. When *PC Magazine* last looked at caching disk controllers ("Hard Disk Access in No Time Flat," June 12, 1990), we picked Distributed Processing Technology's $1,825 SmartCache PM3011/75 as our Editors' Choice. However, all of the other caching controllers we tested (CompuAdd Corp.'s $495 HardCache/ESDI, Konan's $1,395 TenTime TNT-2210, and Perceptive Solutions' $890 hyperSTORE-1600) delivered impressive disk performance improvements.

On PC Labs' tests, however, software caching leapt far ahead of other disk acceleration techniques. Windows 3.1's SMARTDrive 4.0 in system RAM boosted disk performance by a factor of nearly 20 with the combination of an IDE disk drive and an ISA expansion bus. The improvements with other interfaces and drives varied considerably; on the ISA bus, neither SCSI nor ESDI disk drives got even half the performance boost of IDE drives. On the EISA bus, however, SCSI and ESDI drives pulled

HIGHLIGHTS

Mass Storage

YOUR MAIN interface choices for a hard disk today are IDE (integrated drive electronics) and SCSI (small computer system interface). IDE hard disks now come with capacities of 500MB—enough for even a power user. SCSI, with its complex installation procedure, is better suited to file servers.

CURRENTLY, most hard disks fit 5.25-inch or 3.5-inch bays and measure either 1.6 inches (half-height) or 1 inch (one-third height). Virtually any capacity hard disk, up to 500 MB, is available in a 3.5-inch form factor. To accommodate Microsoft Windows and its applications, you should buy a new PC with a minimum of 100MB of hard disk storage.

A SOFTWARE disk cache such as SMARTDrive can increase throughput 20 times over an uncached disk. For DOS applications, software cache is a more effective (and cheaper) solution than buying a disk controller with a built-in hardware cache. The caching disk controllers PC Magazine Labs tested increased disk performance by 30 to 360 percent better than an uncached disk. Combining hardware and software caches resulted in better performance than hardware cache alone, but worse performance than software cache alone.

ON A SYSTEM with 4MB of RAM, a 2MB disk cache is ample. If you have more memory, a 4MB cache is recommended, and a 6MB cache will be able to contain the contents of almost any Windows application.

ONE FLOPPY disk drive is not enough. Buy a PC with high-density 3.5-inch (1.44MB) and 5.25-inch (1.2MB) floppy disk drives. High-density drives can read double-density floppy disks, but double-density 5.25-inch drives cannot read high-density floppy disks.

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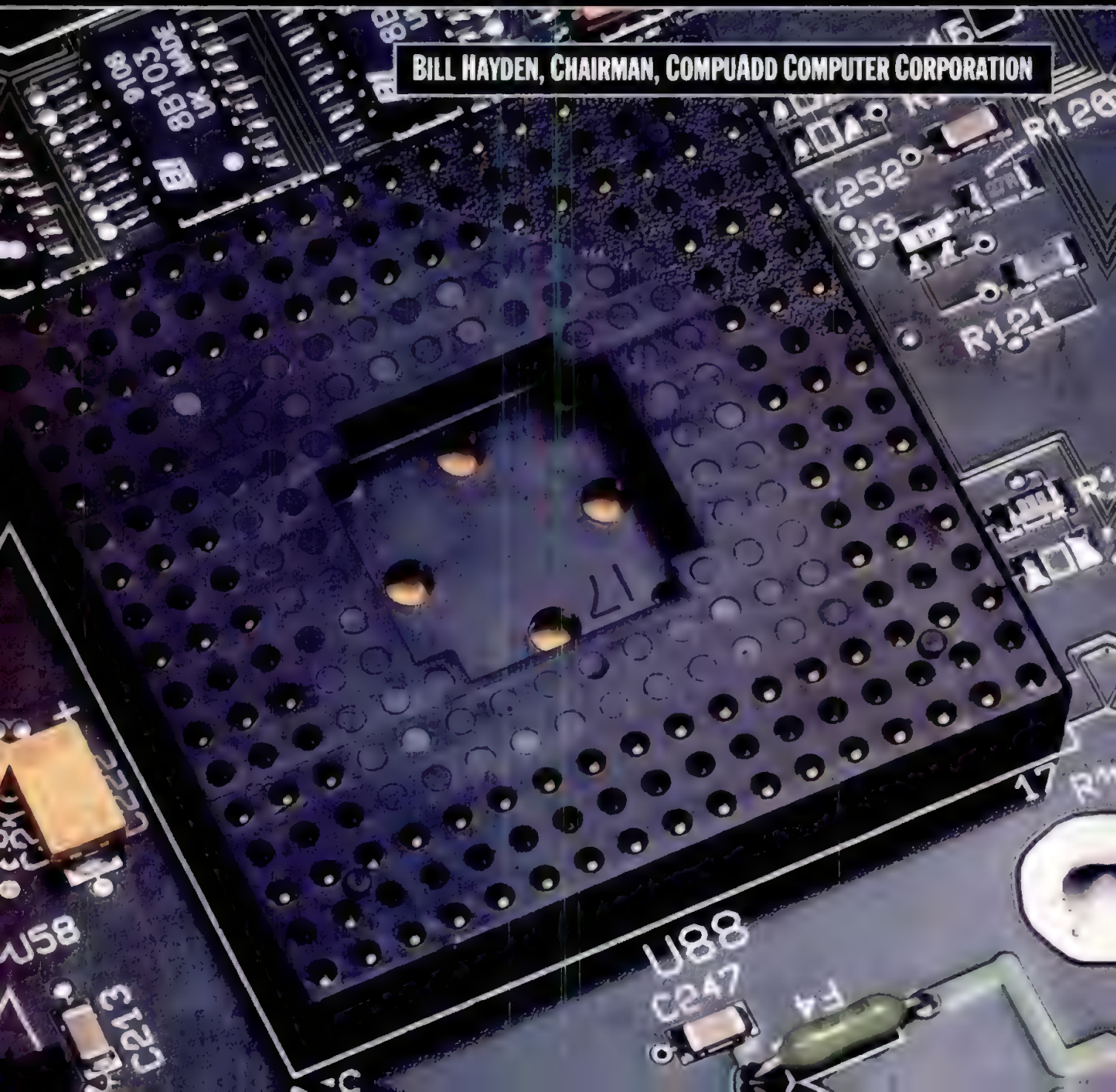
Bill Hayden, Chairman, CompuAdd Computer Corporation



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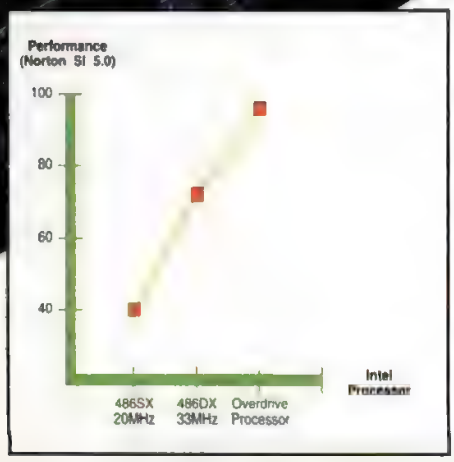

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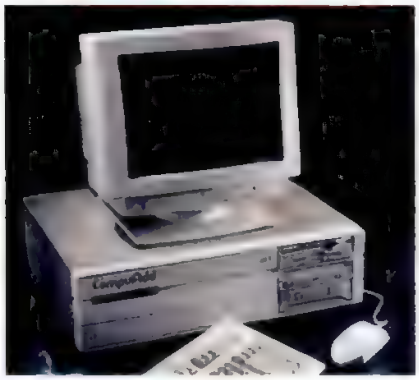

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ahead of IDE in overall performance.

The results achieved by other software disk caches (including earlier versions of SMARTDRV.SYS) will differ. But you can expect a substantial improvement from software caching, enough to make the least-expensive drive equal the best.

The performance of any disk cache will vary depending on how your software uses the disk; for example, a cache won't help in reading large graphics from the disk but will accelerate database sorts. It may also vary with the size of the cache. PC Labs tested with the default SMARTDRV.EXE configuration, 2MB of cache. Most applications should be able to operate within that cache, but if you deal with large files or with many small files that total larger than 2MB, adding more cache will add disk speed. If your computer has 12MB RAM or more installed, you can comfortably designate 6MB for cache and be able to operate any standard Windows application and all of its overlays within that cache.

Combining hardware and software caching rarely yielded an improvement over software cache alone on PC Labs' tests. The only substantial performance increases with double-caching appeared with the IDE and SCSI interfaces on the EISA bus, and these only matched cached-IDE speed on the ISA bus. In

▪ Disk Performance:
Software Cache Boosts Throughput up to 20 Times

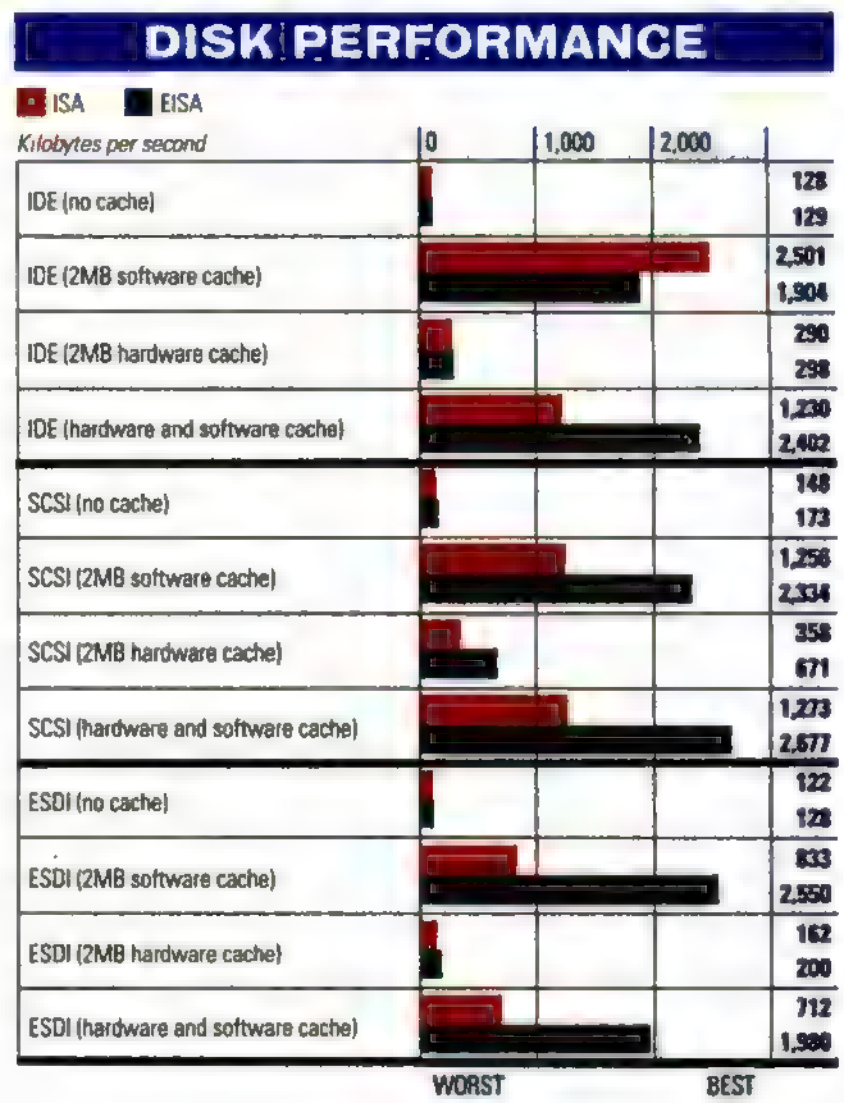
For basic DOS applications, the key to disk performance is a software disk cache—a usually inexpensive addition that can improve a disk's performance by 7 to 20 times. Caching disk controllers are showing up often but your best cache buy is the one that comes free with Microsoft Windows 3.1: SMARTDrive 4.0.

PC Magazine Labs allocated 2MB of RAM for SMARTDrive and compared software disk-cache test results against those resulting from no cache, a hardware cache only, and combined hardware/software cache operations. We found few dramatic performance differences between the IDE and SCSI interfaces, with one exception: The ISA motherboard's software-cached IDE performance was double that of the corresponding software-cached SCSI hard disk. The ESDI unit lagged behind the SCSI and IDE hard disks in every category but one: On our EISA motherboard, the ESDI hard disk with SMARTDrive 4.0 outperformed the IDE unit by 34 percent. This difference is attributable to the ESDI drive's EISA controller, which it used instead of a 16-bit AT interface board. The ESDI/SMARTDrive 4.0 combination also was 9 percent faster than the SCSI hard disk and 32-bit controller.

In cached configurations (hardware or software), EISA outperformed ISA almost 2 to 1 for SCSI and ESDI when 32-bit EISA controllers were used; without caching, there wasn't a great benefit from EISA.

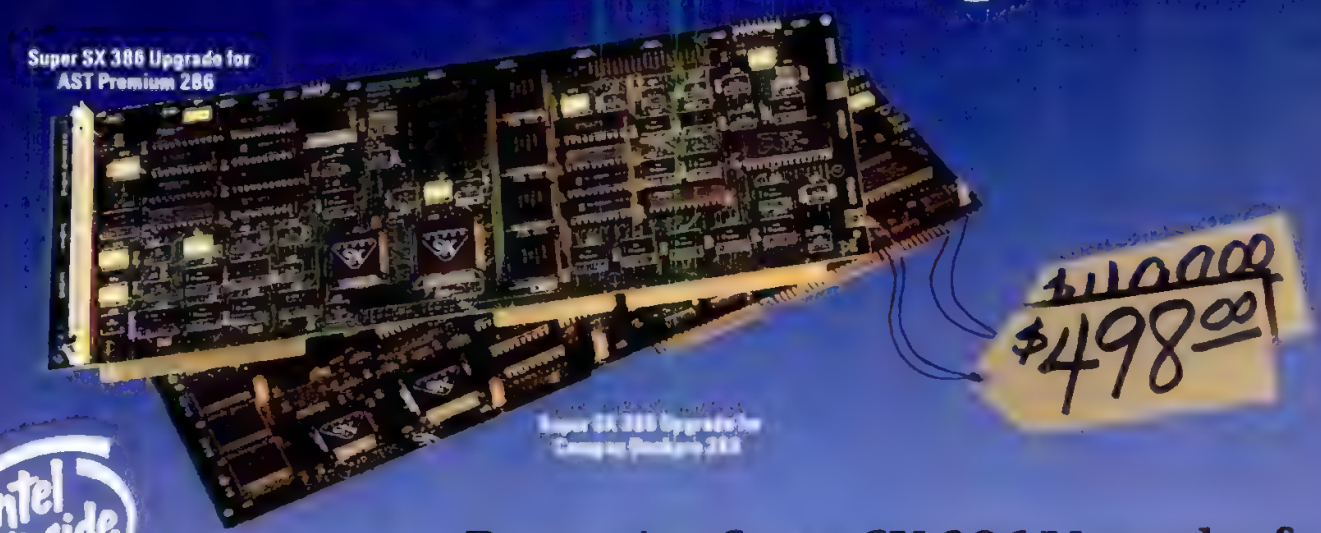
SMARTDRV.EXE with 2MB of RAM is three to four times as fast as the hardware cache implementations we tested. Ganging hardware and software cache gained little when we tested the units with files that fit in the software cache. With a hardware cache, the data must flow across the I/O bus, but with a software cache, data flows directly to the CPU via the faster memory bus.

To test the different disks and caches, we set up IDE, ESDI, and SCSI test-beds and tested them on our AMI 486DX/33 EISA and ISA motherboards with different caches. Our IDE setup consisted of a 340MB Maxtor LXT340A hard disk with a 16-bit cached UltraStor Ultra 15C IDE Caching Disk Controller (hardware-cached EISA) and a Silicon Valley AT-interface controller (uncached and software-cached EISA). Because our ISA motherboard had a built-in IDE interface, it didn't need an adapter for the uncached and software-cached disk tests. The SCSI test-bed included a 340MB Micropolis 1684 hard disk and four versions of the DPT SmartCache Plus disk controller (Model PM2011 for uncached and hardware-cached ISA, and Model PM2012B for uncached and hardware-cached EISA). For our ESDI test-bed, we used a Micropolis Model 1564 hard disk with UltraStor's Ultra 12F ESDI Caching Disk Controller (uncached ISA and EISA), Ultra 12C ESDI Caching Disk Controller (hardware-cached ISA), and Ultra 22CA EISA Caching ESDI Disk Controller (hardware-cached EISA).



We connected each of these combinations to AMI ISA and EISA 486DX/33 motherboards and ran PC Magazine Labs' Hardware Performance Tests, Release 6.0, including variable file-size tests up to 2MB.

How To Go Windows Shopping On A Fixed Budget.



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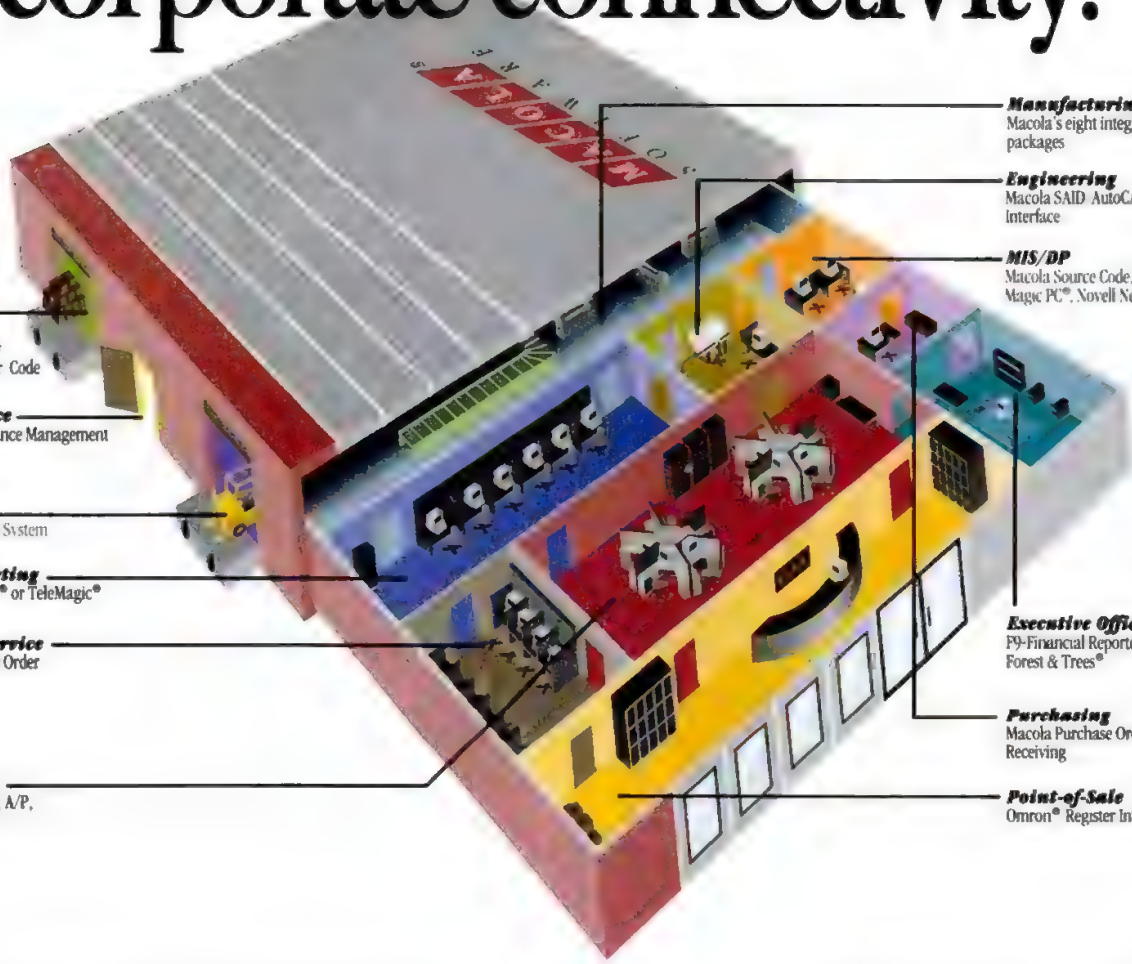

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other words, you are not likely to gain an advantage from the extra dollars you spend on a hardware cache, at least with an IDE drive and ISA-based computer under DOS. Other operating systems—particularly those lacking add-in software caches (NetWare, for example)—make a hardware cache the best disk performance enhancement.

The consistency of raw disk performance scores across interfaces is no surprise. Each of the three popular interfaces has its own maximum transfer speed: ESDI disks operate at up to 3.125MB per second; IDE at 4MB; SCSI at 5MB. However, these speeds describe only the maximum rate at which data can be passed through the interface, not the rate at which bytes actually move from disk to your PC. Information is typically read from the disk at a slower rate, so the limit imposed by the interface doesn't enter into the equation. Because manufacturers typically use the same drive mechanism with the various interfaces, you can expect roughly the same raw performance from ESDI, IDE, and SCSI hard disks.

INTERFACE ISSUES

Forget the long-running debate about which interface is fastest. If you use a disk cache, you'll get similar results from any current drive. Today, you have two real choices: IDE or SCSI. ESDI appears to be following ST506 into obsolescence. Uncached IDE and SCSI disks and controllers performed about equally well on our benchmark tests. SCSI lagged a bit on the ISA bus, and raced a bit ahead on EISA. The only time disk interface becomes important is when you add to your system—either with the installation of the disk itself or when plugging in peripherals later.

IDE hard disks are easy to install, cost less than SCSI and ESDI disk-and-controller combinations, and are available with capacities of 500MB. An AT-style motherboard hard disk connector is little more than a specialized expansion slot, one whose bus interface circuits reside on the motherboard instead of an expansion board. Your system ignores the IDE connector when nothing is plugged in. Attaching a hard disk is like sliding a hard disk controller board into an expansion slot.

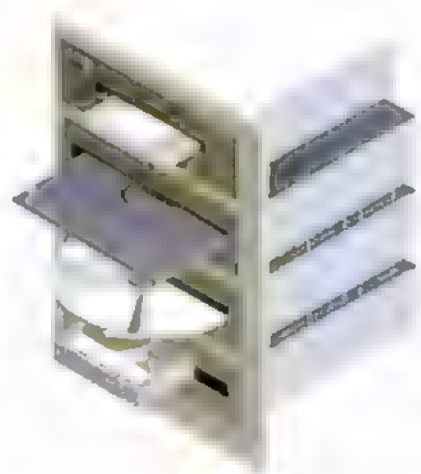
To hook up an IDE hard disk, you need only plug in one signal cable and a power cable. A second disk daisy-chains to the first. One disk then becomes the master (drive C:) and the other the slave (drive D:), typically selected by a jumper on the disk itself. Although early IDE hard disks (more than two years old) from different manufacturers sometimes proved incompatible as master and slave, all current products work together without worry.

ESDI hard disks follow the pattern set by ST506 disks ten years ago. You plug a controller board into an expansion slot, then attach one or two disks to the controller. A control cable links the two disks in a daisy-chain, and each gets its own signal and power cables. System-resource usage (namely, BIOS addresses and interrupt) is set by jumpers or switches on the controller board.

In an IBM-compatible PC, the ESDI hard disk controller's drive-select jumper is set for device 1 (as opposed to 0). The first disk, drive C:, attaches at the end of the cable and must be terminated. That is, terminating resistors must be installed on the drive (most drives include them by default) to control signal reflections. Drive D: plugs into the middle of the cable and must be unterminated (that is, you must remove the termination resistors from it).

ESDI is entering its twilight years. Although the interface, with its current 20-MHz and 25-MHz implementations, suffers no major speed disadvantage compared with the state-of-the-art interfaces (IDE and SCSI), it affords drive makers few technical benefits for eking more capacity from smaller drives.

In testing our ESDI hard disk and controller combinations with hardware and software caches, we found that their performance generally lagged behind IDE and SCSI disks. ESDI showed an advantage only on an EISA motherboard and only when a software cache was installed.



IDE hard disks are easy to install, cost less than SCSI and ESDI disk-and-controller combinations, and are available with capacities of 500MB.

SCSI: UNIVERSAL INTERFACE?

SCSI was designed as a universal interface, meant to be a means to connect anything to your PC, from the fastest hard disks to tape drives, printers, and scanners. Whether you should be included in SCSI's universe is another matter entirely. While SCSI promises many benefits, it's also the most frustrating interface to deal with. Most desktop PCs are better served by IDE disks. However, if you want the greatest capacity, SCSI is the only choice in new hard disks beyond about 600MB. You'll also be stuck with SCSI if you want to use a rewritable magneto-optical drive or CD-ROM drive (SCSI is written into the standards for these hardware formats), or for Bernoulli Box or Syquest removable media disk systems, which also use the SCSI interface.

Beyond those specialized applications, SCSI has many appealing features that apply mostly in the high-capacity/high-performance disk drive range that is the realm of file servers. SCSI permits arbitration between any of the seven devices and can electrically disconnect itself from a PC's expansion bus so that, for example, one hard disk can be backed up to tape while another serves your PC.

Better still is SCSI-2, which adds more performance potential to the interface. SCSI's highest data transfer rate (5MB per second) will increase to 40MB per second in the future under the related SCSI-2 standard. Fast SCSI doubles the SCSI clock rate to 10 MHz for synchronous transfers, and wide SCSI broadens the SCSI data path to 16 or 32 bits. But SCSI-

2 is primarily a standard that better defines the signals and features of SCSI; SCSI-2 devices need not include the fast or wide enhancements. SCSI-2 products are backward-compatible with ordinary SCSI.

SCSI's virtues are lost if you just want to connect a hard disk to your PC. While packaged SCSI systems—disk, host adapter, and software—will work flawlessly from the box, you're apt to run into problems when you venture beyond a simple installation—one drive to one host adapter.

The problem with SCSI is software. Originally created for minicomputers, SCSI deals with data differently than DOS; whereas DOS uses sectors of information, SCSI works with blocks. SCSI host adapters must convert from one to the other, and there is no universally accepted way of handling the software needs of devices other than hard disks (such as tape drives and CD-ROM players). That means some host adapters won't work with some SCSI devices. You need a plethora of drivers to make a complex SCSI system work.

Even more confusing, two software standards currently exist for SCSI: ASPI (Advanced SCSI Programming Interface), originally created by Adaptec and now having the widest industry support; and CAM (Common Access Method), the work of an industry committee (which includes Adaptec) that has yet to gain momentum. A few vendors follow neither standard. In theory, CAM will link directly to operating systems; ASPI uses layered software drivers. However, because CAM support is not built into DOS, you'll have to load drivers under either standard. Drivers made for one standard won't work with the other; in fact, some products (thankfully not hard disks) may be specifically for ASPI or CAM.

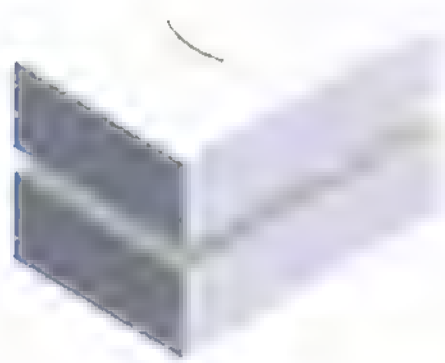
SCSI cabling can also be confusing. To connect a SCSI system, you need to assign each of the SCSI devices you want to connect its own SCSI ID number (0 to 6, with 7 reserved for the host adapter), using the switches or jumpers on each drive. The devices daisy-chain together, and the first and last device in the chain must be terminated. The host adapter is usually one end of the chain, except when both internal and external devices (Bernoulli Boxes, for instance) connect to one host adapter.

A single 50-wire ribbon cable links internal SCSI devices. External cabling is more critical. It should be shielded and devices should be separated by at least 1 foot of cable. The total length of all cables in the SCSI chain should be no more than 19.6 feet. Most SCSI connectors look like enlarged Centronics printer connectors with 50 pins, though devices and host adapters use 25-pin D-shell connectors like serial and parallel ports. Adapter cables for matching the two types of connectors are standardized and readily available.

A number of SCSI-related problems stem from the shortsightedness of host adapter makers. For example, some manufacturers hard-code the use of I/O port address 330 (hex)—a favorite of MIDI peripherals and other cards—into the SCSI adapters. Unless you can change the second card's address, you won't be able to use both devices. (See the sidebar "Keep Your IRQs and I/O Addresses Straight.")

In short, SCSI still is not mature enough for plug-and-play operation with PCs. Although it has potential, the industry has not made its promises reality. The safest SCSI strategy is buying all your SCSI peripherals at once as a package from one dependable vendor. Let the vendor configure everything and assure that all the components will work together. If you do want to add more SCSI devices later, go back to that source or find a dealer who will work with you to achieve compatibility.

It's safe to buy a system with one high-density, double-sided floppy disk drive in each flavor (3.5- and 5.25-inch)— or consider the new dual media half-height drives.



FLOPPY DISK OPTIONS

Floppy disks remain the choice for program distribution and data interchange. They are cheap, reliable, and everywhere. Even though many vendors offer base-PC models with just one floppy disk drive, you should still get a system with two drives, a 3.5-inch and a 5.25-inch. Even after eight years of availability, 3.5-inch disks have not completely displaced 5.25-inch floppy disks. Exchanging disks with a notebook PC requires a 3.5-inch drive, but 5.25-inch disks are still widely used.

Four kinds of floppy disk drives are currently available: double-sided, double-density 5.25-inch (320K or 360K capacity); double-sided, high-density 5.25-inch (1.2MB capacity); double-sided, high-density 3.5-inch (1.44MB capacity); and double-sided, extra-density 3.5-inch (2.88MB capacity).

You can safely disregard single-sided and 720K drives, which became obsolete in 1982. Single-sided 5.25-inch disks can be read from or written to in any 5.25-inch floppy disk drive. Similarly, 1.44MB or 2.88MB drives can read from and write to 720K floppy disks.

It's safe to buy a system with one high-density, double-sided floppy disk drive in each flavor (3.5-inch and 5.25-inch); at this point, the extra-density, 2.88MB floppy disk drives have yet to gain mass acceptance. The disks themselves are also expensive; typically $8 each from people that sell 1.44MB disks for 50 cents.

Wherever possible, you should standardize on high-density floppy disks and drives, because compatibility issues can arise when you use double-density disks. High-density 5.25-inch drives will read 360K disks with no problem. A 360K drive may not be able to read a disk written by the high-density drive, however. High-density 5.25-inch drives use narrower heads than double-density units to squeeze in 80 tracks per disk; double-density units create 40 tracks. In writing double-density disks, the narrow high-

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Folded edge of the page

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GbsSlipSheet-001

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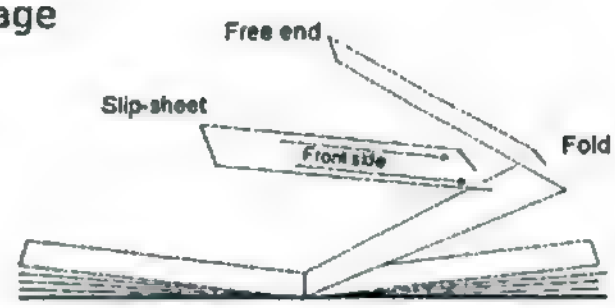
1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



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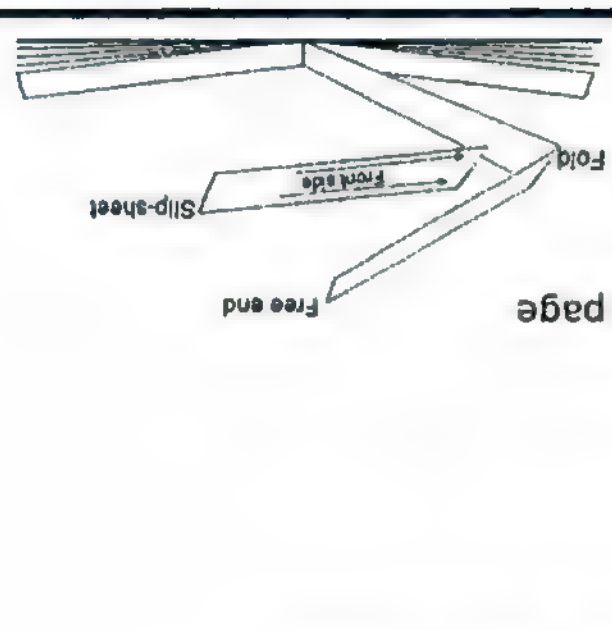

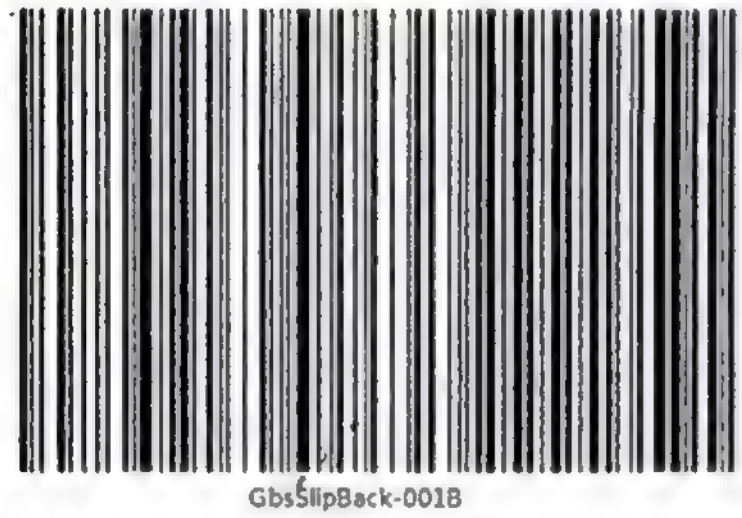

Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

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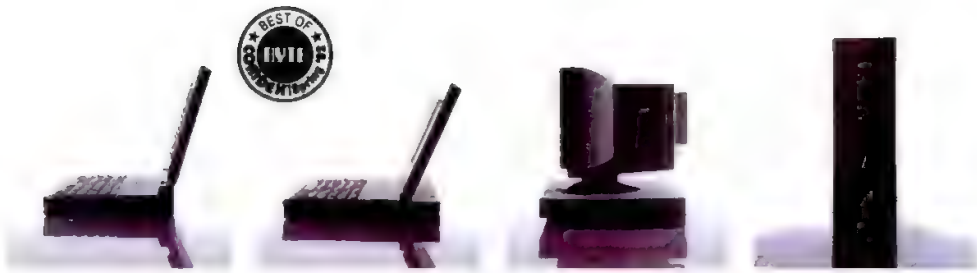

	Z•SPORT	Z•NOTE	Z•STATION ISA	Z•STATION EISA	Z•SERVER EISA
Processor/MHz	i386•SX/25 i486•SX/20 i486SX/25	i386SL/20 i386SL/25	i386SX/25 i486SX/20 i486SX/25 i486DX/33	i486SX/20 i486DX/33 i486DX2/50	i486SX/25 i486DX/33 i486DX/50
Storage	60, 85, 120MB*	60, 85, 120MB*	80, 120, 200, 400MB	120, 200, 400MB	300, 400, 500MB* (up to eight)
Memory (Standard/Max)	2/8MB* 4/12MB*	2-4*/12MB	4/64MB	4-8*/128MB	4-8*/192MB
Video	VGA display up to 64 gray scales	VGA display up to 64 gray scales or active matrix color	Integrated SVGA @ 1024x768 resolution with 16 colors. Upgradeable to 256 colors.		Integrated SVGA @ 1024x768 resolution with 16 colors. Upgradeable to 256 colors.
Pre-installed Operating Systems	MS-DOS 5.0 with APM	MS-DOS 5.0 with APM, Microsoft Windows 3.1	MS-DOS 5.0 Microsoft Windows 3.1		MS-DOS 5.0*
Integrated Connectivity	N/A	Novell NetWare, Microsoft LAN Manager, Banyan VINES client shells pre-installed	Novell NetWare, Microsoft LAN Manager, Banyan VINES client shells pre-installed		Novell NetWare, Microsoft LAN Manager, Banyan VINES, SCO™ UNIX®**
Upgrade Options	Memory, HDD, Coprocessor	Video display, Memory, BIOS, HDD, FDD, Coprocessor	CPU, Memory, BIOS, FDD, HDD, Coprocessor, OverDrive™ processor, Windows accelerator module (WAM), SCSI module, SCSI tape backup, hard drive		CPU, Cache, BIOS, HDD, FDD, Coprocessor, OverDrive processor, SCSI streamer and DAT tape drives, CD-ROM drive, LAN boards, Serial port boards
Mouse	Optional	Logitech™ TrackMan® Portable	Microsoft Two-button		Optional
Battery Life	2 or 2.5 hours under APM*	4-10 hours under Premier System Management™ (⅓ less in color)	N/A		N/A
Weight	6 or 6.2 lbs.*	5.9 or 6.5 lbs.*	N/A		N/A
Optional Peripherals	AT Docking Unit 3 slots AT compatible 2 half-height drive bays	READYDESK port replicator	N/A		N/A

intel inside

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**Pending certifications

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density head leaves a band of unaltered disk around the information it writes. A double-density head will read this band along with the desired information. As a result, the double-density drive may mistake the data that it reads, and may produce errors.

This compatibility problem does not arise with 3.5-inch disks, because the widths of the heads used for double- and high-density drives are the same. Instead of more tracks, high-density 3.5-inch drives squeeze more information onto each track. In theory, an extra-density 3.5-inch floppy disk drive should be equally adept at formatting double- and high-density disks. Today, a 1.44MB drive will give you the best combination of cost, capacity, and compatibility.

You'll find 3.5-inch floppy disk drives in both half-height and one-inch form factors. The small size makes it possible to squeeze more drives bays into a computer case (or, for that matter, a notebook computer). One-inch-high drives are available from a number of manufacturers, including Canon (MD6501), NEC Technologies (FD1158C), and Teac (FD-155GF). The reduced height brings no operational disadvantage.

If space is really tight, you can choose a two-in-one drive that combines high-density 5.25- and 3.5-inch drives bolted together behind a single half-height bezel. Currently, there are two models available: the Canon MD-5511-V6 (an OEM product only) and the Teac FD505/02. These two combination drives actually simplify installation because one connector serves both drives. (You can use your other floppy connector for a minicartridge backup system.) A jumper on the combo unit determines which one of the two is the boot drive.

Floppy cabling in IBM-compatible systems follows a number of rules. All drives are set up to be the second drive in a system, and a cable twist distinguishes drive A: from drive B: (A: comes after the twist at the end of the cable, B: comes before the twist in the middle). The A: drive should be terminated; the B: drive unterminated.

Floppy disk connectors are keyed to prevent them from being plugged in upside down, but the keys (tiny plastic strips in the connectors) may fall out. A red or blue stripe on the cable indicates the side of the connector that goes nearest the notch in the floppy disk edge-connector on the back of the drive. Complicating matters are some systems that use pin connectors instead of the more common edge connectors. Your only strategy is to match connector types with the proper cables.

New technology has made mass storage easier than ever before. The rules are simple: Stick with a pair of floppy disk drives (1.2MB and 1.44MB), buy the hard disk capacity you need (100MB to 200MB are your best bets today), and add a software disk cache (SMARTDRV.EXE or a commercial cache) to get the best disk performance possible. Unless you need a unique feature of SCSI, opt for an IDE drive. You'll have fewer headaches and no regrets. □

Video

The Greatest Performance Improvement for the Smallest Investment

Of all the things you can do to tune your PC's performance, upgrading your display adapter gives you the biggest performance boost for the smallest cost. Among contemporary PCs (486DX/50s to 386SX/20s), there's about a 5-to-1 ratio in PC performance (processor and memory) between the fastest and the slowest. Among current video designs used by these PCs, the performance ratio approaches 20 to 1.

If you're buying a powerful system, you should match it to a fast video adapter. If you have an older PC, a fast card may extend its life another year or two. If you're moving from DOS to Windows applications, you will be transferring about 100 times more information per screen and will need more powerful video.

The video subsystem consists of the *video adapter*, the *video driver* software (supplied with the adapter or the applications software), and the *monitor*. The adapter can be an 8- or 16-bit expansion bus add-in card, or it can be installed on the motherboard. In order to find the most effective adapter, you need to consider the resolution and color capabilities you will need, the card's circuitry—particularly the video chip and the digital-to-analog converter (DAC)—and how the image moves from your system to the video adapter (whether through the expansion bus or a high-speed connection directly to the microprocessor).

This section covers video adapter technology and video drivers; the peripherals section covers monitors.

VIDEO BASICS

VGA (for Video Graphics Array) technology dates to 1987 and IBM's introduction of the PS/2. VGA provides a basic graphics resolution of 640 pixels (picture elements, or dots) across by 480 pixels down, with 16 colors or gray shades. In DOS text mode, VGA resolution is 720-by-400.

Given that today's VGA cards can cost less than $100, few if any vendors equip PCs with adapters based on earlier standards: the low-resolution, 320-by-200 CGA (introduced in 1981), text-only 720-by-350 MDA (1981), or 640-by-350 EGA (1984). In fact, all but a handful of vendors provide VGA cards capable of 640-by-480, 800-by-600 (Super VGA), or 1,024-by-768 (sometimes informally called extended VGA) resolutions, with both 16 and 256 simultaneous colors. IBM is the major exception. It attempted to establish two 1,024-by-768 standards, first 8514/A (1987) and more recently XGA (1990), with mixed success. Some even go to 1,280-by-1,024. The higher resolutions allow you to display more and crisper information on-screen.

All software today supports basic VGA. For higher resolutions, you will need to install drivers for your software

HIGHLIGHTS

Video Adapters

OF ALL PC components, the video adapter shows the greatest possibility of boosting system improvement for the smallest investment. Today's fastest video adapters perform 10 times as well as the slowest, and possibly 20 times as well by the year's end. Accelerator cards currently cost from $200 to $500 (street price).

THE VIDEO adapter or video card (along with the CPU) is responsible for video speed (the monitor has no effect on speed). The video card and the monitor are jointly responsible for the quality of the displayed image.

VIDEO ADAPTERS fall into three categories: frame buffer, accelerated, and coprocessed. Accelerated cards run several times faster than frame buffers. Coprocessed video cards are fast and expensive.

AN ACCELERATED card on a slow PC (for instance, a 20-MHz SX) runs Windows faster than a frame buffer card on a fast PC (say, a 33-MHz 486).

MOST VGA cards operate at 640-by-480, 800-by-600 (Super VGA), and 1,024-by-768 resolutions. With 1MB of RAM, cards can display 256 colors at all resolutions.

VIDEO ADAPTERS using video RAM (VRAM) instead of DRAM (dynamic RAM) run significantly faster.

UNDER MICROSOFT Windows, a well-written video driver improves performance significantly, in some cases by 50 percent.

VIDEO CIRCUITRY installed on a high-speed local bus in upcoming personal computers promises to boost Windows and DOS performance substantially. But not all video circuitry on the motherboard is local-bus video.

applications and operating environments. Higher-resolution modes work best with graphical environments such as Windows 3.1 or OS/2 2.0, which provide their own, unified way of accessing high resolution: Install one set of drivers for the environment and you've assured video compatibility with all programs that run in there.

Outside Windows and OS/2, there is limited support for standard higher-resolution interfaces, despite the efforts of the Video Electronics Standards Association (VESA). Most video cards support higher resolution for AutoCAD; they may also have drivers for the best-selling DOS-based spreadsheet, word-processing, and graphics programs: Lotus 1-2-3, WordPerfect, and Harvard Graphics, respectively.

BEYOND 16 COLORS

The resolution and the number of colors offered by a video system are constrained by the memory installed on the display adapter. Standard VGA puts 16 colors on-screen at a time. Most VGA cards can also display 256 simultaneous colors. Higher resolutions for up to 16.7 million colors are in the offing. The higher the display resolution and the more colors it contains, the more memory you will need on your display adapter to hold a full screen image. VGA adapters have 256K, 512K, or 1MB of memory.

Basic VGA requires 4 bits, or a half-byte, of memory per pixel to display 16 colors. Why four bits? Each bit represents two choices, and 2 x 2 x 2 x 2 ($2^4 = 16$). For 256 colors, you need 8 bits ($2^8 = 256$), or 1 byte per pixel; 16.7 million colors requires 24 bits (2^{24}=16.78 million), or 3 bytes per pixel. The accompanying chart shows how much video memory you will need at various resolutions and colors. For 16-color VGA and Super VGA, you need only 256K of video memory. For 256-color 1,024-by-768 video, you need 1MB. Other resolutions and color depths need 512K.

TRUE-COLOR VIDEO

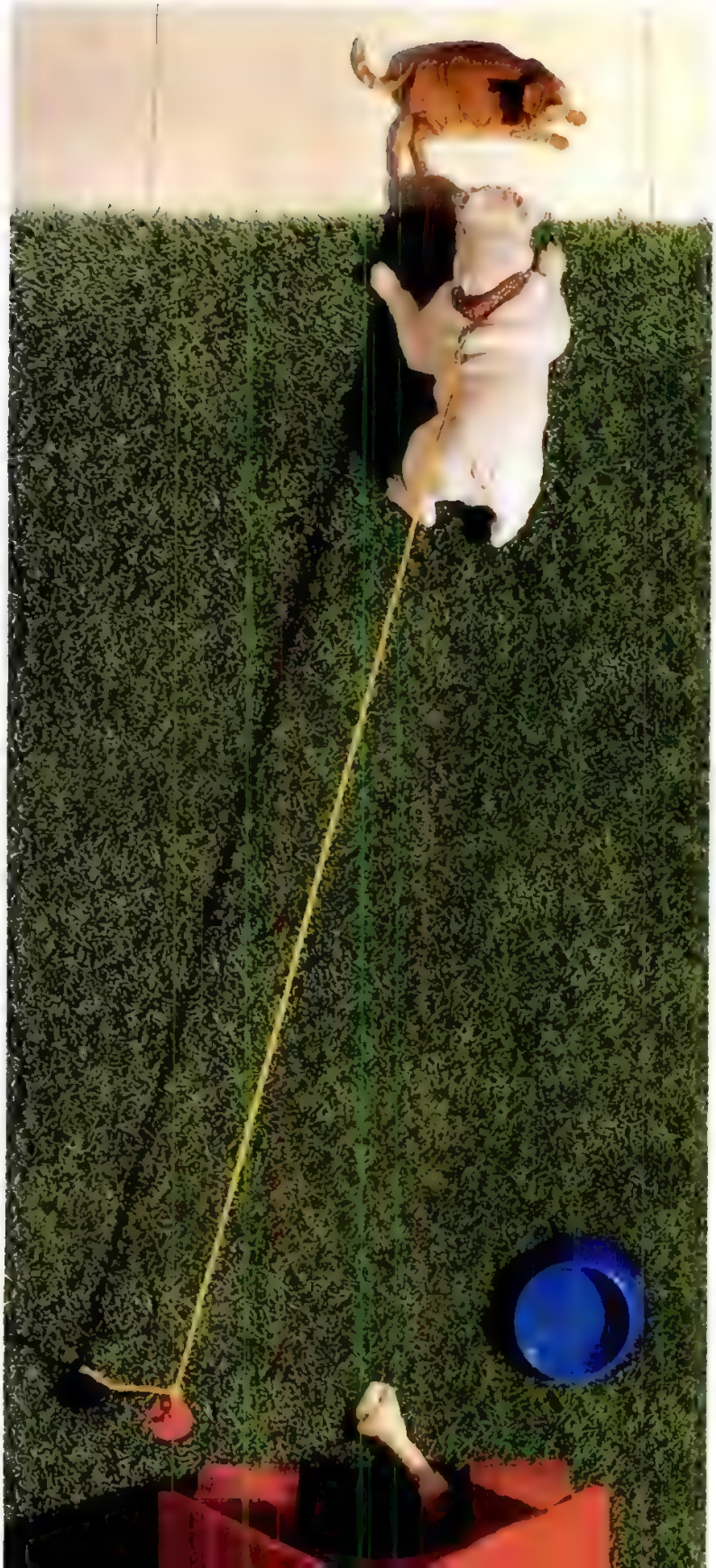
The number of colors you need depends on your applications. Stay in text mode and you won't have a worry: 16 colors is all you get. You probably won't need more when you change to graphics mode and run a CAD program or make simple charts and graphs. As you move to more sophisticated graphics or on-screen presentations, you will find that 256 colors provides a more seamless background without resorting to *dithering*, the use of dots and cross-hatched lines to imitate unavailable colors. Mainstream video in mid-1992 is 8-bit, or 256 colors.

When it comes to applications that require realistic hues, you will want as many colors as you can afford. Wider spectra require video adapters based on more costly chips and use more memory, which requires more time to manipulate. With an optimized palette, 16-bit color (2 bytes per pixel, providing 64K hues) approaches the limit that monitors can display and is adequate for all but the most critical viewing. For painstaking work such as publishing and photo retouching, 24-bit color (16.7 million hues) is required.

Video memory limits the number of colors that your video board can store. The spectrum your PC can actually put on-screen is set by the board's DAC (or RAMDAC). A standard VGA DAC can produce 256K hues because it has three color channels (one red, one blue, and one green), each with 6-bit color, making it an 18-bit color system. Memory limits VGA storage to 8 bits per pixel. Color look-up tables (CLUTs) let you match one of the 256K possible colors with an 8-bit code to be stored in memory, so that either you or your software can choose which of the 256 colors from the board's palette will appear on-screen at any given time.

While 256 colors drawn from 256K can approach realism, such images are far from perfect. You could simply add more memory to a VGA board, but this is problematic. While a video adapter can in theory use any number of bits for storing color, the storage system must follow some standard so that the software can take advantage of it. Several standards have been developed for spreading the PC rainbow.

Edsun Laboratories, now part of Analog Devices, developed its continuous-edge graphics (CEG) chip to increase the number of colors on-screen with no



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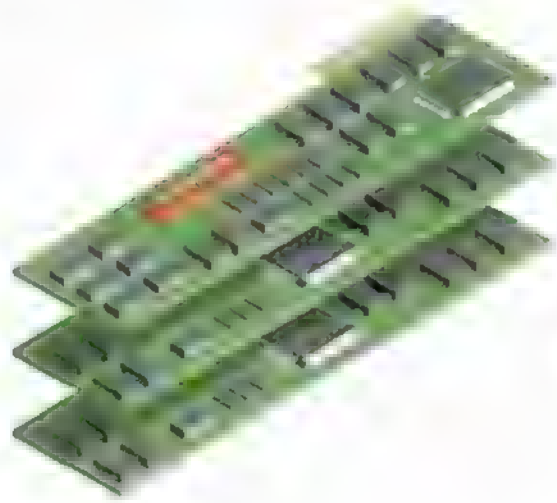
memory penalty. The Edsun/Analog Devices chip exchanges 32 of VGA's 256 colors for mix values, which indicate the ratio for "blending" adjacent color dots. The result is smooth transitions between colors at their borders or edges—colors that blend together gradually—with a minimum loss of sharpness. The drawback of the Edsun CEG system is that your programs will need to know the chip's special codes for color mixing, and few applications take advantage of it. The Sierra Hi-Color RAMDACs are another alternative. These follow existing standards instead of minimizing memory requirements. One series of Sierra chips offers 32K simultaneous on-screen colors—5 bits for each primary color—based on the True-Vision TARGA color system. The 64K-color versions of the Sierra chips give 5 bits to red and blue, and then allocate 6 bits to green; this follows the 16-bit color standard set by IBM's XGA system. In either case, you must allow 2 bytes of display memory for every pixel (and your software must have matching drivers). True-color display adapters typically give each primary color its own 8-bit DAC for 24-bit color.

MAKING VIDEO FASTER

The more bytes in an image, the more data that must be computed and moved to display it 60 to 72 times per second. Fortunately, the entire screen does not often change with every frame; images are held in the display system's memory—the frame buffer—until they are changed. Painting a small window on a graphics screen only affects those buffered bytes associated with that window. But if you scroll a graphical screen, every pixel must shift. You've seen the effect: The scrolled image appears a line at a time, slowly painted down the screen. The higher the image resolution and the more colors, the slower the display response. The problem is that in the traditional display system, the microprocessor must move every byte into the frame buffer. The frame buffer knows how to do nothing on its own, which is why it's also called a *dumb frame buffer*. The speed of this operation depends on the microprocessor's power, the speed at which the data can be transferred from the microprocessor to video memory, and the circuitry of the display adapter. Performance improvements can be made in a number of ways:

- A faster CPU. A quicker microprocessor can process the video data at a faster rate. PC Magazine Labs' tests of four video cards found that when they ran on a 486/33, their speed increased by up to 33 percent over when they run under DOS on a 386SX/20; this increase was as much as twice as fast under Windows. Ultimately, however, you reach a point of diminishing returns, when the microprocessor can make and move an image faster than its data can be transferred across the expansion bus and into display memory.
- VRAM. Changing the adapter's memory architecture helps video response. Normal memory chips—dynamic RAM, or *DRAM*—are single-minded. At any given instant, they can either read or write, but they can't do both because they have a single port. Consequently, your system must wait to write new screen data while the display adapter sends the image to the screen 60 to 72 times per second. Video RAM, or *VRAM*, breaks this bottleneck with a second port, allowing simultaneous reads and writes. Display adapters using VRAM and dumb frame buffers are often twice as fast as DRAM-based boards. VRAM chips cost about twice as much as DRAM; consequently, the boards are more expensive. For example, the ATI Graphics Vantage contains 1MB of DRAM and has a list price of $449. The ATI Graphics Ultra card uses 1MB of VRAM and has a list price of $699. Note that some boards are available with either DRAM or VRAM, so make sure you're clear about which you want when you order your board.
- Text mode. In text mode, transfers take place on a character-by-character basis rather than pixel-by-pixel. (A character generator translates each byte into the 9- by 16-pixel VGA character displayed on-screen.) In text mode, the CPU transfers up to 4K per frame (2,000 bytes, or characters, per 80- by 25-character screen, plus 2,000 attribute bytes) versus 150K to 250K per graphical frame. Graphical displays must transfer 100 or more times as much information to build a screen.
- Lower resolution, fewer colors. Running your PC with a 1,024-by-768, 256-color display involves five times the data overhead of 16-color VGA. You'll get a bit more speed if you back down a bit. Note, however, that a newer video adapter will still be several times faster at any resolution and color than a two- or

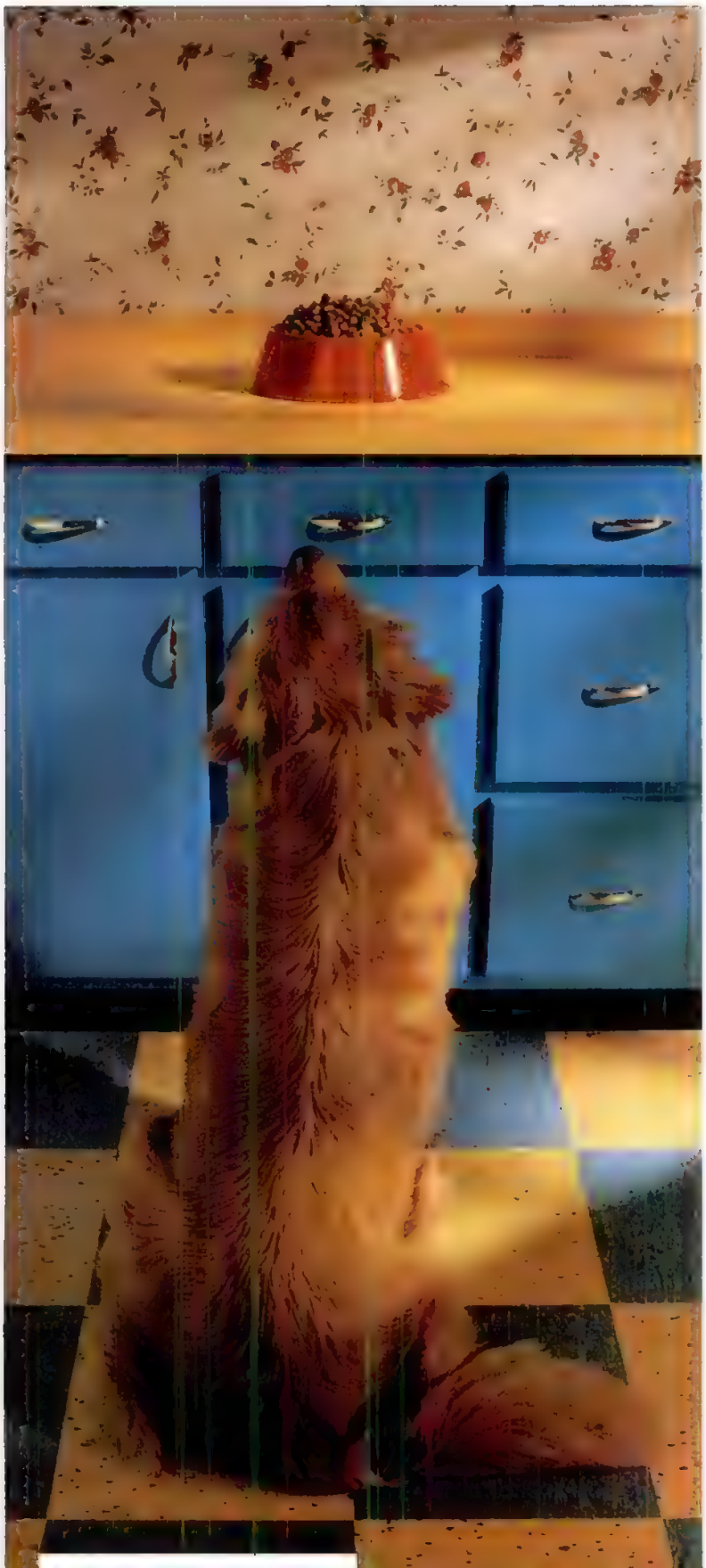


Display adapters using VRAM and dumb frame buffers are often twice as fast as DRAM-based boards, but VRAM chips cost about twice as much as DRAM.

Bits of Video Memory Required

Graphical PCs require from 150K to nearly 4MB of video memory to display images. In comparison, an 80- by 25-pixel text-mode display needs just 4K. This chart shows how many pixels are displayed in four common graphics modes, and how much memory you need to display 16-, 256-, and 16.7-million-color images.

Resolution	Pixels	16 colors (4-bit)	256 colors (8-bit)	16.7 million colors (24-bit)
640 x 480 (VGA)	307,200	153,600	307,200	921,600
800 x 600 (Super VGA)	480,000	240,000	480,000	1,440,000
1,024 x 768	786,432	393,216	786,432	2,359,296
1,280 x 1,024	1,310,720	655,360	1,310,720	3,932,160



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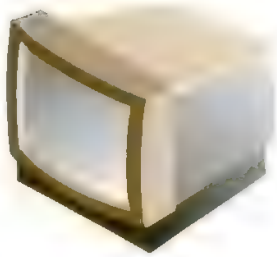
three-year-old VGA card at 640-by-480 resolution with 16 colors.

■ Updated drivers. The software driver can have as much impact on video performance as all other factors put together. PC Labs has seen updated Windows drivers that ran 50 percent faster than the immediately previous versions. When a major new program ships, particularly Windows, a vendor may release two or three versions of the driver one to two months apart, each significantly faster than the previous version. Make sure you have the latest driver. Other driver tips: If there's a generic driver provided with Windows (even for vanilla VGA) and a product-specific driver available from the video board maker, the brand-specific driver often will be significantly faster. In some cases, a 256-color driver is more efficient (faster) than a 16-color driver, even though it's moving around twice as many bytes of information. Try both, since we suspect the vendor spent more time and effort tuning the 256-color driver. Finally, third-party software companies like Panacea (800-729-7420, 603-437-5022) sell fast Windows drivers called software "accelerators" (not to be confused with video accelerator boards, discussed below). They're available for video chip sets that are popular and, in Panacea's opinion, do not have highly efficient drivers.



Accelerated BitBlts make a screen scroll more quickly—except for the last few lines, which appear much more slowly because they must be generated fresh or transferred from the CPU.

ACCELERATORS, COPROCESSORS

Video adapters fall into one of three categories: frame buffer, accelerated, or coprocessed. A frame buffer generally comes with most systems if you don't specify an upgrade. Accelerated and coprocessed video adapters are significantly faster than frame buffer video adapters, although accelerated video adapters aren't significantly more expensive.

Video coprocessors and accelerators achieve higher speeds partially because they trim the amount of data that needs to be transferred to the display system, just as text-mode adapters do. Instead of coded character matrices, however, coprocessors and accelerators receive coded, or cryptic, instructions describing how to generate the on-screen patterns of pixels—how to draw a line or box, or fill an area with color. The coprocessor or accelerator on the display adapter itself generates the image, relieving the microprocessor. For example, most video chips take over the bit-block transfer (BitBlt) operations that are required to move data from one area of video memory to another. Accelerated BitBlts make a screen scroll more quickly—except for the last few lines, which appear much more slowly because they must be generated fresh or transferred from the microprocessor. Optimized for image generation, coprocessors and accelerators can often work faster than your PC's general-purpose microprocessor. Moreover, the video chips work in parallel with the main microprocessor.

The difference between the coprocessor and the accelerator is programmability. The accelerator is a fixed-function coprocessor, with built-in abilities to handle specific graphics actions related to particular programs and applications. The coprocessor can be programmed to do anything; the accelerator is hard-wired for certain graphics operations. The versatility of the coprocessor adds to the cost: Coprocessed boards start at about $750 and accelerated boards around $200. For programs accelerators are designed to handle (typically graphical environments like Windows and CAD programs such as AutoCAD), accelerators can equal or even better the performance of true coprocessors. When *PC Magazine* last examined video adapters ("Graphics Accelerators: Pump Up the Power," March 17, 1992), the best accelerators outran a true coprocessor on many tests.

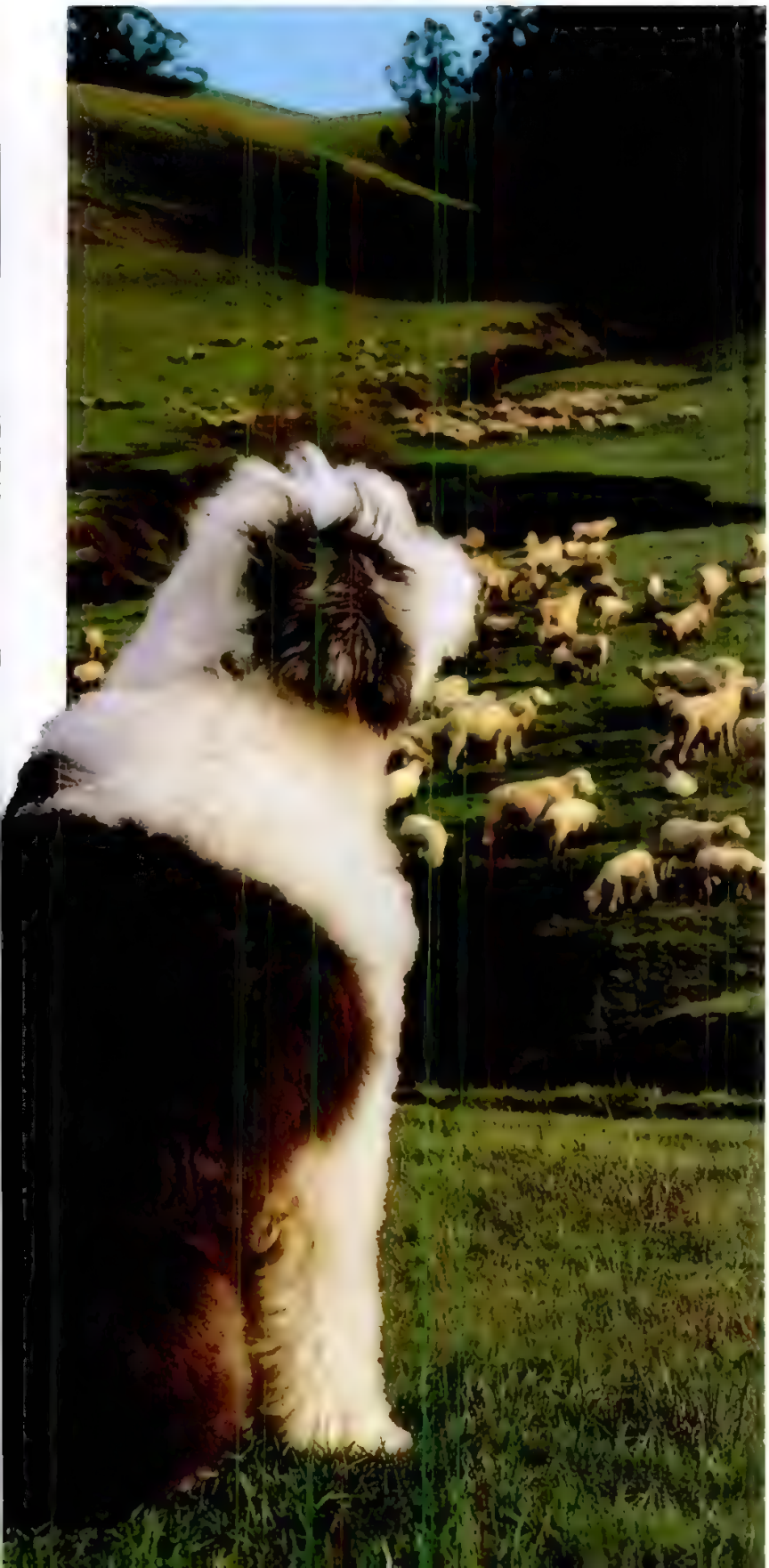
Several chip makers offer accelerators. These include ATI (the Mach 8 chip), Chips and Technologies (the 82C453), ITT (the UV6000), S3 (the P86C911), and Weitek (the W5086). The two adapters that received an Editors' Choice distinction in the March 17th story—the Diamond Stealth VRAM and Portacom Eclipse II—were based on the S3 chip. Other manufacturers using the S3 chip include Actix Systems, CSS Laboratories, Genoa Systems Corp., Orchid Technology, Pixel Engineering, and STB Systems.

The display adapter's circuitry and its BIOS also influence display speed because some designs are simply better than others. Five years ago, manufacturers were challenged just to build fully IBM-compatible VGA circuitry; today compatibility is assured and manufacturers have a number of VGA chips to select from, including those from Trident Microsystems, Tseng, and Western Digital.

LOCAL-BUS VIDEO

Another way to speed the transfer of video information from your system's microprocessor to the screen is to put a quicker connection between them—sidestep the slow expansion bus with a more direct link. Putting display circuitry on a PC's motherboard is not enough, since such systems electrically connect their system-board video circuitry to the PC through the same input/output interface used by the expansion bus. The only difference is the elimination of a connector. This design does not necessarily improve performance, however. The electrical design, not the bus connector, holds back the transfer rate.

Local-bus video designs take the video circuitry off the expansion bus and add a new link direct to the microprocessor. The local connection—which can be either hard-wired to video circuitry on the motherboard or plugged into a new expansion-bus design—operates at memory speed and with a full 32-bit bus width, giving it an appreciably higher speed potential than an expansion-bus connection. Moreover, while the high transfer rates



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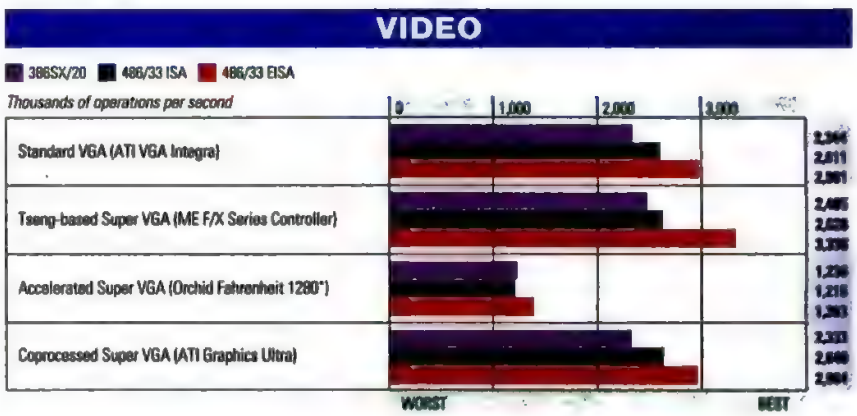
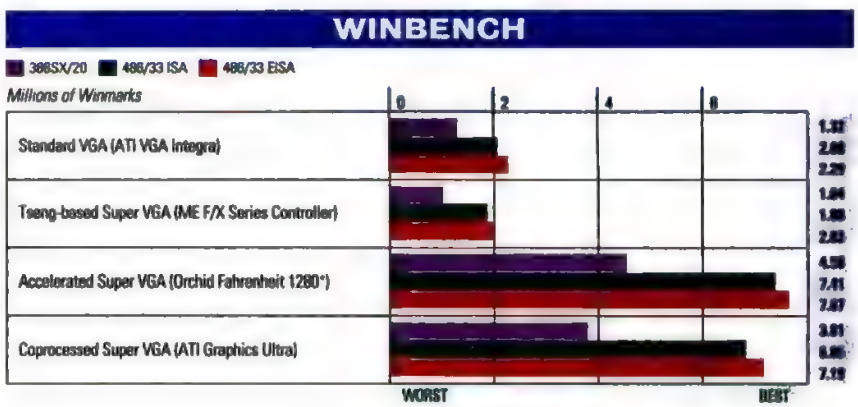
promised by advanced expansion buses like Micro Channel and EISA require special software commands, local-bus designs work at full speed with all traditional applications—no modifications or special drivers required. Of course, you will need a local-bus computer to get the benefit of the local bus; you can't just add a new bus to your existing PC. NEC introduced the first local-bus PCs with circuitry on the motherboard. Most PC manufacturers are readying new products to take advantage of local-bus designs, although many are holding off their introductions until bus standards are formalized. These manufacturers have three local-bus designs to choose from: One is based on the OPTi chip set, another is a standard being hammered out by VESA; and the last is under development at Intel and is called PCI (Peripheral Component Interconnect). The OPTi design simply provides a means of connecting peripherals directly to a microprocessor's local data and address buses. The VESA design adds many of the features of the EISA and Micro Channel advanced expansion buses such as the bus-mastering capabilities required by the XGA display standard. The Intel design was not disclosed yet, but it will likely incorporate all the features of the VESA local bus. In fact, Intel and VESA are working together, and the final Intel

▪ Video: *Accelerators Make Windows Perform Best*

A 33-MHz 486 boosts Windows graphics performance 60 to 80 percent over that of a 386SX/20. In a purely DOS environment, though, a speedy CPU has far less impact—35 percent or less. Likewise, a coprocessed or accelerated video card boosts Windows performance about threefold, but it actually may perform worse under DOS than a dumb-frame-buffer video card.

To compare the performance of different video adapter technologies, we chose four ISA video cards: a basic VGA card (the ATI VGA Integra), a Super VGA card with the popular Tseng ET4000AX chip (the Super VGA Micro Express F/X Series Controller), an S3 chip–based accelerated card (the Orchid Fahrenheit 1280°), and a Super VGA video coprocessor (the ATI Graphics Ultra). Using our computer setup, we ran Release 6.0 of PC Magazine Labs' Hardware Performance Tests and Version 2.5 of WINBENCH on three platforms: a 386SX/20 ISA, 486DX/33 ISA, and 486DX/33 EISA. We tested all cards at 800-by-600 resolution with 16 colors.





Windows-based raster operations benefited from the faster CPU. The ATI VGA Integra, along with the Orchid Fahrenheit 1280° card, showed an average 60 percent improvement from the 386SX/20 to the 486DX/33 (ISA) platforms; the Micro Express F/X Series Controller (Tseng chip–based) and ATI Graphics Ultra registered 80 percent gains.

On each processor platform, the Tseng chip–based F/X Series Controller, Integra, and Ultra cards turned in comparable DOS-based video test scores. As we have seen from PC Labs' past evaluations, however, the S3 chip–based Orchid Fahrenheit 1280° was only about half as fast as the others on the video test.

Under Windows, the accelerated Orchid Fahrenheit 1280° card shone. In all cases, its Windows performance was more than triple that of a dumb-frame-buffer card. The coprocessed ATI Graphics Ultra did comparably well. The message is clear: If you're running Windows, look for a video adapter that features accelerator chip sets and companion drivers; improved drivers can make the difference between good and great performance.

Since all four cards were 16-bit ISA types, we attribute a 10 percent performance improvement on our EISA platform to the EISA motherboard's support chip set and 128K RAM cache.

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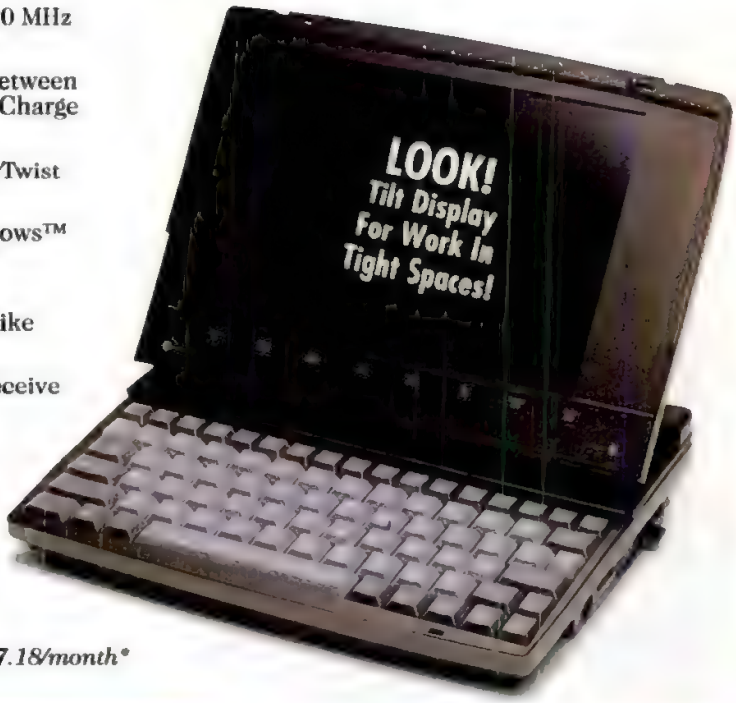

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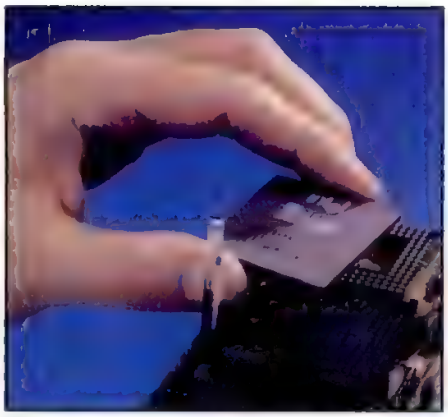

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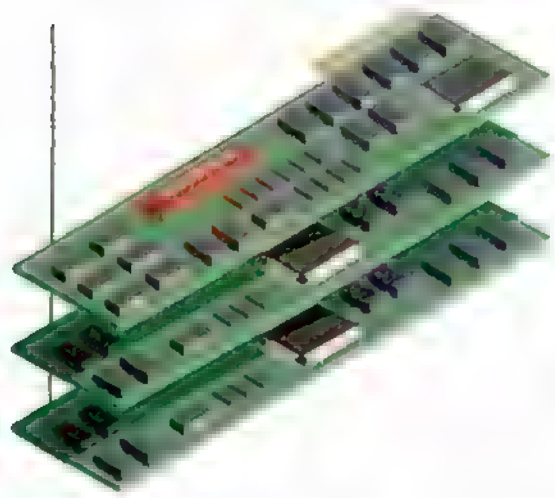
design may very well be VESA-compatible. (Technically, because the Intel and VESA buses are arbitrated, they are not truly local-bus designs. But no better name has been proffered.)

An aside: The local bus has potential beyond video. It can improve performance whenever vast amounts of data must regularly be moved between peripherals or peripherals and memory. Both existing local-bus designs now allow for up to three expansion slots. (The slot count has to be kept low because of interactions between the high frequencies of the local bus—up to 66 MHz—and connector capacitance.) That's enough to accommodate all the peripherals that are most limited by the low bandwidth of traditional expansion buses, such as a video board, hard disk host adapter, and network adapter.



On Windows operations, our 386SX/20 test-bed PC with accelerated video was more than twice as fast as a 486DX/33 with ordinary VGA, showing that a PC can last longer with the right video.

The potential speed improvement of the local-bus approach is great—four to eight times as fast as a traditional expansion bus from higher clock speed alone. But you probably won't see video performance race ahead commensurately. The accelerator approach leaves little data to push across the bus. On PC Labs' WINBENCH test, a motherboard with an early local-bus video implementation (the Chips and Technologies Wingine) ran the test in only about 15 percent less time than an S3 chip–based accelerated video system in a 33-MHz 486-based PC. On the other hand, PC Labs measured about a fourfold difference between local bus and a dumb frame buffer–based board in the 33-MHz machine—exactly what the higher speed of the local-bus design would predict. An accelerator will give you nearly all the performance of current local-bus systems without the need to buy a new PC. For an extra boost, manufacturers are also beginning to place accelerated video cards on the local bus.

Video performance also depends on other variables, particularly your PC's microprocessor and your applications. The microprocessor must generate the image. Different applications call upon different aspects of video performance.

Your system's BIOS (Basic Input/Output System) sometimes affects these issues; sometimes it doesn't. Simple text-only applications rely on the code in a display adapter's VGA BIOS to write to the screen. For these applications, the efficiency of the BIOS code determines the display speed. A faster BIOS will accelerate the video performance of these applications. Alternatively, you can use a video accelerator to replace slow video BIOS routines. Many applications, including all major word processing and spreadsheet programs, write directly to the screen, substituting their own code text-handling for that in the BIOS. For them, the BIOS is meaningless, and their speed is determined by your video board's circuitry itself.

VIDEO PERFORMANCE TESTS

To put the factors that most affect video performance into perspective, PC Labs compared the results of four video cards installed in three PCs (a 20-MHz 386SX, 33-MHz 486 ISA, and 33-MHz 486 EISA) using two test suites simulating normal VGA access and Windows. The four video card types were a VGA card with an entry-level, sub-$100 selling price (the ATI VGA Integra); an improved VGA chip based on the highly popular Tseng ET4000 chip set (Micro Express' ME F/X Series Controller); the most popular Windows-optimized accelerator, based on the S3 911 chip (the Orchid Fahrenheit 1280°; and a general-purpose accelerator (the ATI Graphics Ultra). All four were 16-bit ISA cards; only some lower-performance cards are still 8-bit. We did not test a video adapter based on a coprocessor chip, like the Texas Instruments TMS34020, because in past testing this chip's performance advantage over accelerator cards run under Windows was less substantial than the price difference.

The results confirmed that accelerators make a huge difference, approaching a fourfold speed increase in Windows-based testing. In fact, on Windows operations, our 386SX/20 test-bed PC with accelerated video was more than twice as fast as a 486DX/33 with ordinary VGA. This suggests that with the right video upgrade, you can extend the life of current PCs that seem too slow under Windows.

Under DOS, the four cards were much closer in performance; the S3-based card was actually slower than the frame buffer cards. You'll want to choose the S3 chip if you plan on working within windows, but the ATI Graphics Ultra's Mach 8 chip is the more appropriate choice if you dabble in DOS or other graphical environments as well. These conclusions, however, are based on the video drivers that were shipping at the time we tested. Among cards with closely matched accelerator designs, the advantage often goes to the board with the most recently upgraded video driver.

The bus had a small effect on video performance. The cards' performance on the EISA motherboard was about 10 percent better than on the ISA. The acceleration was less under Windows than DOS because the microprocessor overhead of Windows in a dumb frame buffer system tends to outweigh differences in transfer rate. The small difference arises because today's buses appear much the same to video adapters. Both ISA and EISA operate at about the same clock speed (8 MHz), and few programs take advantage of the features of the advanced buses (arbitration and 32-bit data path). Moreover, many video functions we test are handled locally in display memory and are unaffected by bus performance.

VIDEO PERFORMANCE SUMMARY

The range of Windows performance between the fastest adapter on a 486DX/33 and the slowest on a 386SX/20 was on the order of 7 to 1. Among systems available

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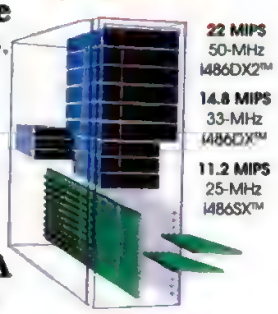

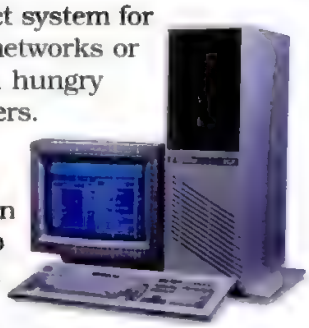

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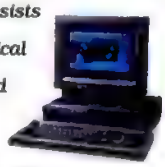

Model	PowerFlex FLYER	Flyer 32 DT	Flyer 32 LCT
CPU Options	I386SX/25	I486SX/20	I486SX/25
upgrades to	I486SX/20	I486SX/25	I486DX/33
		I486DX/33	I486DX2/50
		I486DX2/50	
Memory Arch.	16-bit	32-bit	32-bit
Standard RAM	1-MB	4-MB	4- or 8-MB
Maximum RAM	16-MB	36-MB	64-MB
Memory Cache	8-KB Int. (I486SX only)	8-KB Int.	8-KB Int.
Optional Cache		256-KB (Std. on DX2/50 Models)	256-KB
Expansion Slots	3 ISA	3 ISA	10 ISA
Standard HDrive	60/80-MB	0/80/120/200-MB	0/120/340/535-MB
Drive Bays	3	3	12
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CIRCLE 165 ON READER SERVICE CARD

this year, we believe the ratio may be 20 to 1, perhaps more. The slowest PC-video adapter combination here returned just over 1 million Winmark operations (at 800-by-600 resolution with 16 colors); the fastest, 7.7 million. (A Winmark is the geometric mean of the 12 PC Labs WINBENCH graphics tests, measured in pixels per second.) Apart from this story, PC Labs has tested several near-production-level products returning 10 to 16 million Winmark operations at 1,024-by-768 resolution with 256 colors. By early fall, we expect to see products hit 20 million Winmark operations.

To get the right display adapter for your PC, you will need to consider all these issues—memory, VGA and accelerator chips, DACs, and standards. Higher resolution is a given; all except the least expensive display adapters offer Super VGA and 1,024-by-768 resolutions. Get your video card with 1MB of memory, which allows 256 simultaneous colors all the way up to 1,024-by-768 and costs no more than $50 to $75 more than a 256K or 512K video card. (It costs about $100 extra to get 1MB on a VRAM card).

If you plan on using Windows, you'll want a Windows accelerator. Whatever video adapter you buy, make sure you're using the latest driver. The drivers shipping in the Windows box may not be the latest or the most efficient.

For the utmost in display speed, look at local-bus designs emerging later this year. And remember that not all motherboard video is fast local-bus video. □

Essential Peripherals

Monitors, Keyboards, and Modems

Compared with the rest of your personal computing system, where performance is your primary guide, the selection of peripherals—the monitor, keyboard, and modem—is a matter of personal preference as much as it is performance. These peripherals include the pieces of your PC that you constantly gaze up at and touch—your monitor and keyboard—and those that reach out and contact other PCs—your modem. What's best is what you like best.

SCREEN GEMS: THE MONITOR

What you see is what you have to put up with from your PC. More than any other part of your PC, the monitor you connect will determine how well you work, the detail you'll see, and the headaches you'll get or avoid.

You face several concerns in selecting a color monitor, and they boil down to two: compatibility and quality. Compatibility affects what display adapter you can plug into the monitor (and expect it to work). Quality describes what you see on the screen—how sharp and stable the image appears, whether you can see all the detail that your display adapter can generate. This discussion covers color monitors only, since monochrome monitors are pretty much restricted to network file servers, data entry terminals, and a few other single-task operations.

Today, the standard video system in nearly every PC sold starts with VGA. Many systems reach beyond that to a *Super VGA* mode with 800-by-600 or 1,024-by-768-pixel resolution (sometimes informally called *extended VGA*). Some even extend to 1,280-by-768. Not all monitors are compatible with higher resolutions, however. If you're satisfied with VGA, you can buy an inexpensive VGA-only *fixed-frequency monitor.* To take advantage of the higher resolutions available with modern display adapters, you'll need a *multiscanning* or *multiple-frequency* display, one that can automatically synchronize to the higher frequencies of Super VGA signals. *PC Magazine*'s last look at monitors ("Mainstream Monitors: What Really Matters," July 1991, and "17-Inch Displays: A Better View of Windows," June 30, 1992) concentrated on these multiscanning and multifrequency models.

Monitor frequencies go up with resolution, because the higher the resolution of an image, the more *pixels* or dots it contains. In a color image, each pixel is made from three individual color dots, each represented by a pulse of the video signal. The more dots on-screen in a given period (typically a *frame,* which makes one complete image), the more pulses in that period and the higher the frequency.

FREQUENCIES AND TERMINOLOGY

Three frequencies are important—vertical synchronizing frequency (the *frame rate* or *refresh rate*), horizontal synchronizing frequency (the *line scan rate*), and *bandwidth.* The frame rate, measured in hertz (Hz, or cycles per second), determines the stability of the image on the screen: specifically, whether it flickers like a worn-out fluorescent tube or glows steadily. The line rate, measured in kilohertz (kHz), is the product of the number of lines in the image (its vertical resolution) and the refresh rate. The bandwidth, measured in megahertz (MHz), establishes the highest frequencies in the video signal, which roughly correspond to the number of dots in a line multiplied by the line rate. (Note that because of overhead, the required bandwidth may be higher than the result of the simple multiplication of the numbers.)

The higher the refresh rate, the steadier the image. But increasing the frame rate shortens the time available for painting pixels on the screen, boosting the required horizontal frequency.

The VGA standard requires that monitors be capable of operating at frame rates of 60 and 70 Hz, good enough to eliminate flicker for most people using normal-size (14-inch) monitors. Horizontal frequencies increase with frame rate and resolution. At VGA's 640-by-480 pixels and 70-Hz frame rate, the line rate is 31.5 kHz. The VESA specifications at 800-by-600 resolution include guidelines with a 56-Hz frame rate and 35.5-kHz line rate, a 60-Hz frame rate and 37.8-kHz line rate, and the

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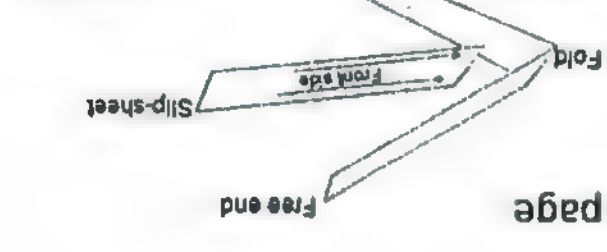

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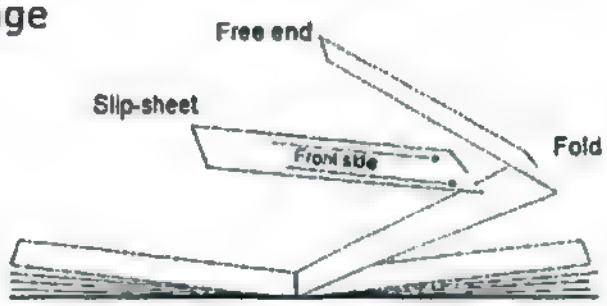

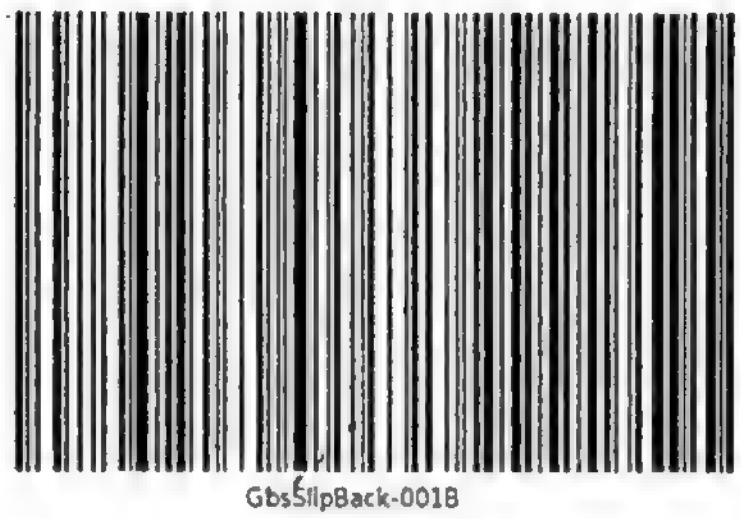

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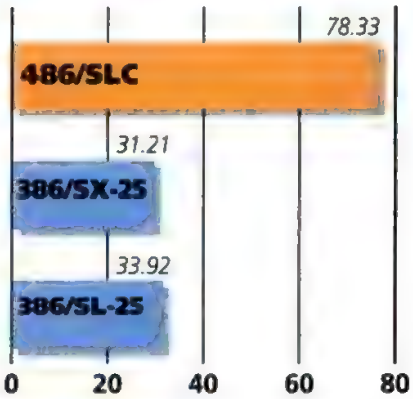

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official specification with a 72-Hz frame rate and 48-kHz line rate. The VESA standard at 1,024-by-768 resolution requires a 60-Hz frame rate and 48-kHz line rate. At 1,024-by-768 resolution, however, *PC Magazine* believes 60 Hz is inadequate—too flickery—especially on larger monitors or for applications that use a white background (such as Microsoft Windows). You should look instead for monitors and video cards that operate at 70 or 72 Hz.

You'll want to be sure that any multiscanning or multiple-frequency monitor you choose is capable of handling the frequencies produced by your graphics adapter. A multiscanning monitor handles all frequencies within its range; a multiple-frequency monitor handles a fixed number of frequencies currently used or anticipated for video standards. A multiscanning monitor (also conversationally called a *multisync* monitor, in honor of NEC's pioneering MultiSync line) may cost a bit more and be more versatile in theory.

OTHER QUALITY FACTORS

Beyond scanning frequencies, a number of other factors influence the sharpness of the image produced by a monitor. Many of these, such as *convergence* (the proper registration, or alignment, of the red, green, and blue electron beams that create each pixel), vary from monitor to monitor in a production run. One, however, is an absolute limit set during manufacture. Every color picture tube has either a *shadow mask* or *aperture grille* that prevents the signals meant for one color from lighting the dots of another color.

A shadow mask is punched with a series of holes to let only the desired beam through in exactly the right places; an aperture grille is a set of stretched wires that accomplishes the same end by setting up a series of slots. Better monitors may have shadow masks made of *Invar*, a metal alloy that expands minimally when heated and helps maintain a sharp image. The distance between the holes or slots determines the monitor's sharpness. Depending on the design of the tube, the smaller this distance (termed either the *dot pitch* or *slot pitch*), the better. For a description of other technical issues affecting monitors, such as *autosizing, barrel distortion, drift, jitter, pincushioning, swim,* and *roping*, refer to one of our recent monitor reviews. While it helps to be familiar with technical detail, you should also know that on all recent PC Magazine Labs tests, our findings categorized monitors into three classes: one or two clearly subpar products that we couldn't recommend, one or two superior performers, and the vast majority that performed quite acceptably.

Exactly what pitch you need for a resolution depends on the screen size. Putting more dots on a smaller screen requires a tighter pitch. For VGA images on a typical 14-inch monitor, you'll want a dot or slot pitch of no larger than 0.31 mm for adequate sharpness. Super VGA images require even finer pitches; 0.28 mm is a practical minimum. Some monitors advertise VGA compatibility (they handle VGA frequencies) but have dot pitches as high as 0.50 mm. You'll find such coarse-pitch screens hard on your eyes.

One issue many people fail to consider is that a monitor is actually only half of a visual communication system. The other half is your eye: Your vision also limits the viewable resolution of a display system. Your eyes simply may not be able to resolve all the detail that a given monitor can display. As on-screen resolution increases, you either have to put your face closer to the screen or get a larger monitor to distinguish fine details. The blame rests on both your visual acuity and the shortsightedness of software writers. Most applications take advantage of higher resolutions solely by packing more characters on the screen—making the text smaller rather than more detailed. In Super VGA mode, characters are 20 percent smaller than in VGA on the same-size screen; in 1,024-by-768 mode they are 37 percent smaller. For most people, a 14-inch monitor is sufficient for VGA and, usually, 800-by-600-pixel images. Moving to 1,024-by-768 requires a larger screen (16 or 17 inches).

You get roughly the same image size on a 14-inch monitor at VGA resolution,

HIGHLIGHTS

Peripherals

MOST MONITORS support VGA (640-by-480), Super VGA (800-by-600) and 1,024-by-768 resolutions. Look for noninterlaced multiscanning or multi-frequency monitors capable of supporting 70 Hz to 72 Hz (frames or images per second) for flicker-free viewing.

THE BEST monitor for a Windows user has a 16- to 17-inch (diagonal) color display and costs about $1,000. The 14-inch monitor may be supplanted by 15-inch monitors at the same price. Monitors with 19- to 20-inch displays, while desirable, are too bulky and costly for widespread use.

HIGHER RESOLUTIONS generally squeeze more small characters onto the screen rather than make same-size images crisper. These combinations give roughly the same image sizes: VGA on a 14-inch monitor, Super VGA on a 16- or 17-inch monitor, and 1,024-by-768 on a 19- or 20-inch monitor.

WITH KEYBOARDS, the major choice is between a click (positive tactile feedback) or silent (soft-touch) keyboard. Mechanical-switch, rubber-dome, and membrane keyboards all have good reliability.

AS DATA modem prices fall below $500, there is less reason to consider anything other than a 9,600- or 14,400-bps modem. And 2,400-bps modems can now be had for less than $100.

V.22BIS, V.32, and V.32bis refer to modulation or speed (2,400, 9,600, or 14,400 bps). MNP 4 and V.42 refer to error correction. MNP 5 and V.42bis refer to data compression.

AN INCREASING number of modems (including external modems) have Group III fax capabilities and are compatible with fax machines anywhere in the world. But they are not very easy to use, especially for receiving faxes.

a 17-inch monitor at Super VGA, and a 19-inch monitor at 1,024-by-768 resolution. Considering that you'll probably be moving to higher resolution, you'll want to put a 16- or 17-inch multiscanning monitor on your shopping list.

Here are some other buying considerations:

■ Many people want 17-inch monitors but the company budget allows for 14-inch monitors only, so many monitor vendors are adding 15-inch monitors to their lines that cost roughly the same as 14-inch monitors and offer a slightly bigger picture (7 percent greater diagonally). A 14- or 15-inch multiscanning or multiple-frequency monitor costs about $500 (street price), a 17-inch monitor costs about $1,000, and a 19-inch monitor (which can be quite bulky) is close to $2,000.

■ The screen image you actually get will be 0.5 to 2.0 inches smaller than the manufacturer's stated diagonal measurement. A 17-inch monitor may display an image anywhere from 15 to 16.5 inches diagonally.

■ If glare is a problem, look for a monitor with an etched screen (which reduces sharpness slightly) or an optional add-on glare filter if the face is polished glass ($100-$200).

■ Most monitors now have tilt-and-swivel bases and front-mounted controls. The monitor may have a DB-15 connector, five BNC connectors, or both for the signal cable. (The connector at the video-adapter end is always DB-15.) BNC-style cables cost more and provide a slightly better image. If the monitor comes with a cable, it's likely to be a DB-15 cable.

■ While many people have concerns about radiation from monitors, there's no clear scientific (as opposed to anecdotal) evidence linking monitors to health problems. However, most monitors built in the last year or two are classified as *low-emissions monitors* that meet all U.S. and virtually all European standards and cost no more than the monitors they supplant.

■ At higher resolutions, especially 1,024-by-768, some monitors are *interlaced*, meaning the video adapter and monitor scan (draw) lines 1, 3, 5, and so forth, then go back and fill in lines 2, 4, and 6. This is a cheap way to get higher resolution, but many users find interlacing causes flicker. Make sure your monitor can handle the highest resolution you want in *noninterlaced* mode.

■ To keep costs down, some noninterlaced monitors stop at 1,024-by-768 resolution, while others go to 1,280-by-1,024. Except for 19-inch and larger monitors, the characters rendered by 1,280-by-1,024 displays are too small to be read comfortably.

■ No CRT (cathode ray tube)–technology monitor has a perfectly flat screen, but some are flatter than others, and they're described by various makers as *flat, flat-square,* or *flattened* screens.

■ When you're shopping for a PC at rock-bottom prices, the cheapest system offered by a vendor may use a monochrome rather than color VGA or Super VGA monitor. Make sure you know what you're getting for that $999 price. Also, if you see a PC listed in an ad by itself, chances are it may not include either the monitor or the video display adapter.

If glare is a problem, look for a monitor with an etched screen (which reduces sharpness slightly) or an optional add-on glare filter if the face is polished glass.

KEYBOARDS, MICE

The place where interactive computing begins is your keyboard. While all of today's keyboards look very much the same, they are very different both inside and in how they feel under your fingers.

Every keyboard is built around a number of mechanical sensors that detect the press of your fingers, typically a switch that closes an electrical circuit. The switch may be a traditional mechanism with precious metal contacts that are forced together (the *mechanical switch keyboard*), tabs of carbon attached to puckered sheets of elastomer (*rubber dome*), or thin plastic sheets printed with conductive traces that are squeezed together (*membrane*). These three technologies have virtually eliminated earlier design choices (*capacitive* and *Hall effect* keyboards) from the marketplace.

Although the form of mechanism used at one time determined the feel of the keyboard, manufacturers now add springs, levers, latches, and all sorts of auxiliary mechanical contrivances to tailor the feel of a keystroke. Today you probably can't tell a keyboard's technology without stealing a glance at its specifications. For example, nearly all available keyboards—regardless of underlying technology—now require about the same amount of force to actuate each key (between 1.9 and 2.5 ounces) and about the same travel (0.14 to 0.18 inches). Only laptop keyboards differ significantly.

Some designs are more complex than others, however. Mechanical switches involve more individual components (springs and so on) and allow easier repair. Mending a contact in a rubber dome or membrane keyboard requires that you replace all the contacts. In fact, such keyboards are best regarded as disposable: The price of a replacement is probably less than the cost of a service call. However, rubber dome and membrane keyboards are far more reliable than in the recent past, when they were considered poor cousins to mechanical keyboards.

The appeal of a particular keyboard is governed by the key layout, the feel of each key, and the effort and displacement required for key activation. Today's keyboard designs make these characteristics essentially independent of the electrical design of the keyboard, as we discovered in our last detailed look at these products, "Replacement Keyboards: The Write Stuff," February 25, 1992.

In typing, the most meaningful difference between keyboards is tactile feel. Manufacturers aim for two styles of touch—a hard *click keyboard* that gives *positive tactile feedback* (a sharp reduc-

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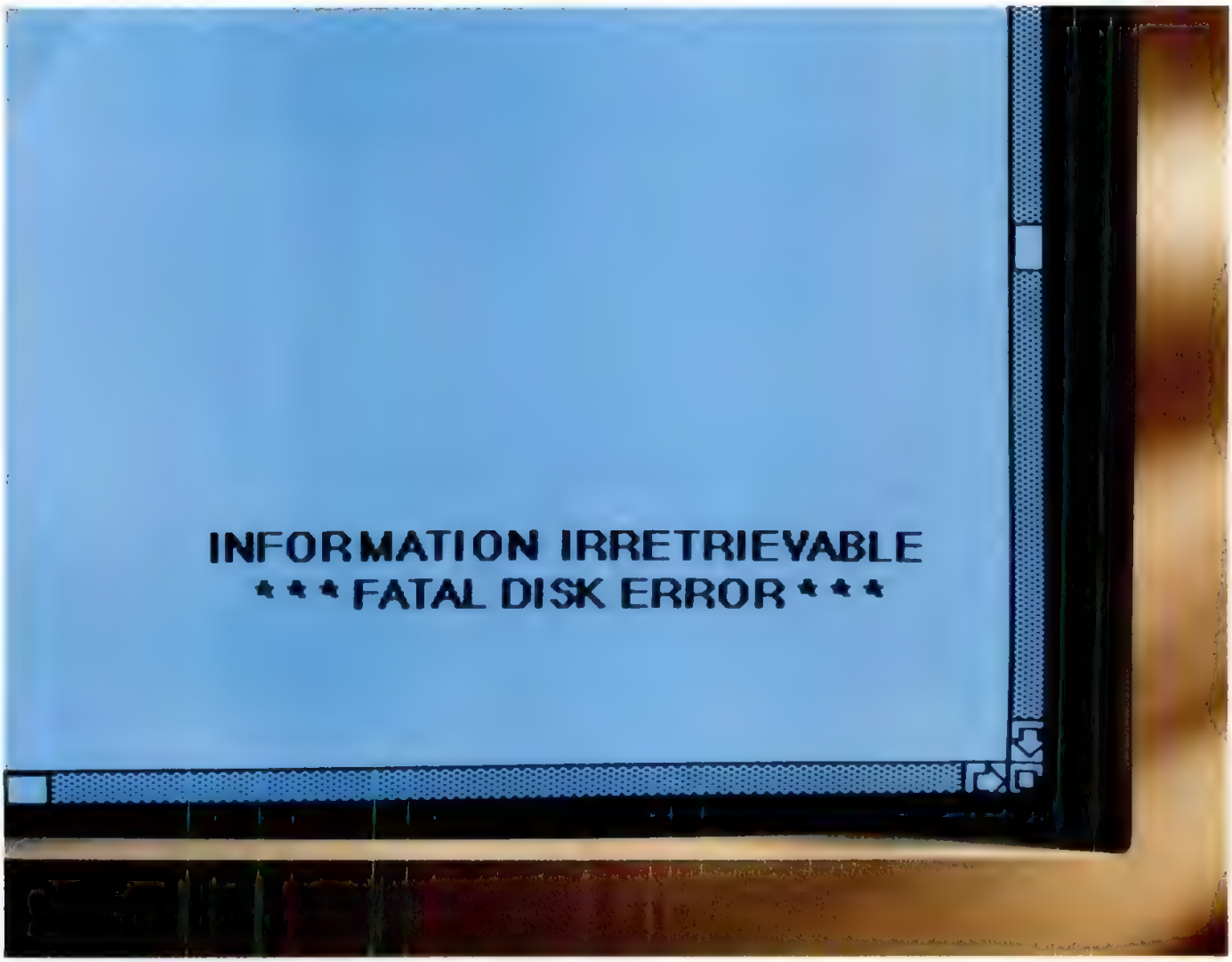

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tion in the resistance to your finger force accompanied by an audible click upon activation of a key) or *soft-touch keyboard* (an essentially linear feel without a click and without any noise) that critics call "mushy" keyboards. IBM's keyboards typify the former; Compaq the latter. Which is best is mostly a matter of personal preference. Sales are split 50/50 between the two.

PC Magazine's most recent Editors' Choice awards favored the hard-click style, awarding top honors to the $217 IBM (Lexmark-made) Enhanced 101-key Keyboard, the $89 Northgate OmniKey/101, and the $129 Northgate OmniKey/Ultra-T. A soft-touch keyboard, the NMB RT-101+ earned an honorable mention as an extraordinary bargain, priced at $31.

Key layout is a religious issue, but one that has been resolved by the simple practicality that almost all systems now come equipped with keyboards arranged in the manner of IBM's 101-key Enhanced Keyboard of 1987 (as were all of the keyboards tested in the February 25, 1992, issue). Of the 101 keys, twelve are function keys on the top row; individual dedicated cursor and numeric keypads are provided, and the Ctrl keys are located under the Shift keys. You'll find minor variations among keyboards, such as enlarged Enter keys, smaller Backspace keys, and the Backslash key relocated to the top row. For those who prefer the pre-1987 arrangement with function keys on the left,

▪ Keep Your IRQs and I/O Addresses Straight

You've just plugged a new fax modem, mouse, or network adapter into your PC, and now your system doesn't work. What happened? If your PC has an ISA bus, as opposed to an EISA or MCA bus, it is likely the new adapter's I/O address or IRQ conflicts with another device in the system.

Every I/O (input/output) device requires both an I/O address and an IRQ (interrupt request). The I/O address is the device's location in memory and is expressed as a four-digit hexadecimal number. A device uses an IRQ to get the microprocessor's attention; when a modem receives an incoming call, for instance, it uses an IRQ to signal the processor. 286s, 386s and 486s have 16 IRQs available (numbered 0 through 15), while 8088s and 8086s have only 8 (0 through 7). Similarly, 8-bit cards must be assigned one of the first 8 IRQs; 16-bit cards can use any unassigned IRQ. In ISA systems, these assignments must be unique, but EISA and MCA motherboards use bus-arbitration methods that allow some devices to share certain addresses and IRQs.

Many input/output address assignments are accepted as standards in Intel 80x86 PCs. For example, COM1 is typically assigned 03F8H, COM2 has 02F8H, LPT1 has 0378H, and LPT2 has 03BCH. (The *H* stands for hexadecimal.) Similarly, COM1 typically defaults to IRQ level 4 (or IRQ4), COM2 to IRQ3, LPT1 to IRQ7, and LPT2 to IRQ5.

Problems arise when you install new boards that use these common addresses as their defaults. Many bus mouse cards, for example, are assigned both the IRQs and addresses used by COM2. Makers of Western Digital Ethernet network cards are equally fond of that pair of assignments. Installing both types of cards require that you reset the address and IRQ of one or both of those cards. To make matters worse, since most mouse and network adapters are 8-bit devices, you're limited to the first eight IRQs.

CD-ROM CONFLICT

You may find another conflict when you install a SCSI CD-ROM drive, which often uses IRQ5—the same as LPT2. Since most SCSI adapters are 16-bit devices, you can assign them higher IRQs. Keep in mind, though, that the higher the IRQ, the lower its priority when the device needs the microprocessor's attention. (IRQ5 gets priority over IRQ7, for example.)

You can avoid many potential conflicts by disabling the serial and parallel ports you don't plan to use, thereby freeing their IRQs and addresses. If you install an internal modem, you will probably have to reassign the COM port that you would have used for an external device.

Many cards also let you reassign their addresses and IRQs. Newer boards provide software utilities for this purpose; older ones contain jumpers or switches that you need to change manually. Occasionally, you will find a card whose addresses and IRQs have been hard-coded and can't be changed; in that case, you'll have to reconfigure the other device. The card's documentation will provide you with default addresses and acceptable options.

WRITE IT DOWN!

The best way to avoid a conflict, however, is to know what IRQs and I/O addresses are available to you before you begin. You should keep a list of these assignments handy for future reference. Then check the new card's documentation to determine if it will conflict with any of those addresses.

Plenty of diagnostic products exist to help identify your system's existing assignments; among them are Dariana's System Sleuth Professional (714-236-1392); DiagSoft's QAPlus, QAPlus/Win, and QAPlus/FE (408-438-8247); Quarterdeck Office Systems' Manifest (310-392-9851); Qualitas's 386MAX and BlueMAX (301-907-6700); Symantec Corp.'s The Norton Utilities (310-453-4600); and TouchStone Software Corp.'s CheckIt (714-969-7746). Microsoft also provides an undocumented diagnostic tool, MSD.EXE, with Windows 3.1.

The documentation for your new addition may also shed some light on suggested assignments and default settings.—ALAN M. STOUGHTON

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products such as the Northgate OmniKey/Ultra-T duplicate all 12 function keys on the top and to the left of the alphanumeric pad.

Keyboard compatibility is a secondary buying concern, because nearly all of today's products work with any computer produced since IBM introduced its AT and a new electrical design for keyboards in 1984. You'll need to verify that your choice of keyboard is backward-compatible with the original 1981 IBM design only if you have an original IBM XT, PC, or similar vintage computer. Even with these older machines, compatibility isn't much of a worry. Nearly all inexpensive replacement keyboards include a switch to select between XT and AT-and-later compatibility; some automatically detect the type of circuitry in your computer. On the other hand, a few keyboards interact badly with Novell's NetWare, so you'll want to check Novell support when you buy.

Most replacement keyboards use the same *5-pin DIN* connectors as most PC-compatible computers (sometimes called an *AT-style* connector). IBM, however, has used a *6-pin mini-DIN* jack on its machines since 1987 (also called a *PS/2 connector*). You'll need either a special cable or an adapter to match PCs that follow this more recent IBM connector standard. It may be supplied with the keyboard.

You can add a mouse, trackball, or other alternate input device at any time. Some PCs are better set up to handle mice. If possible, look for a PC system unit that includes a dedicated connector for your alternate input device. In decreasing order of preference, the connector can be a second mini-DIN (PS/2-style) connector, a connector or add-in card conforming to Intel's *InPort (bus mouse)* specification, or one of the system's one or two serial ports.

MODEMS

The basic purpose of a *modem* is almost elementary—matching the digital signals produced by your computer with the analog characteristics of today's typical telephone line. A modem modulates an analog signal with digital information to send data and demodulates the signal upon receiving the data, hence the name (modem is an contraction of *modulator/demodulator*).

The modulation method marks the main difference between modems. As complex circuitry becomes easier to implement with the refinement of solid-state technology, the modulation schemes by modems have increased in complexity, allowing information to be slipped down the phone line at ever-faster rates. Where once modems moved data no faster than 300 bits per second, products that you can plug into your PC today can outrun your system's communications capabilities with data rates as high as 14,400 bps, or 57,600 bps with compression. (Bits per second technically isn't the same as *baud*, but many people use the two interchangeably. To translate bps to characters per second, divide bps by 10. A rate of 9,600 bps can move about 960 characters per second, or half the contents of an 80-by

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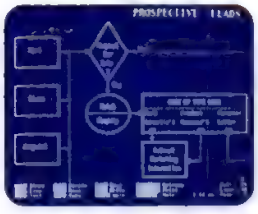

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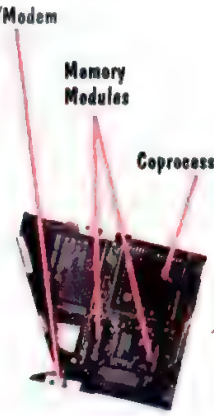

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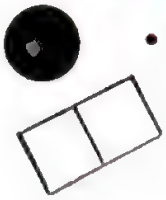

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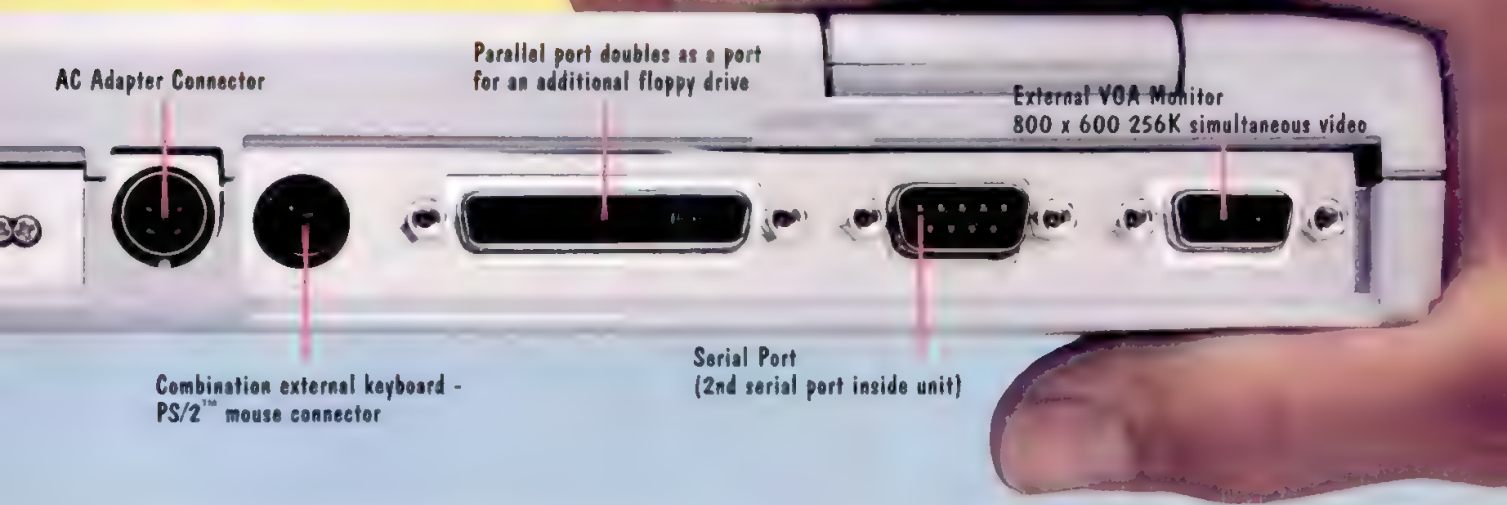

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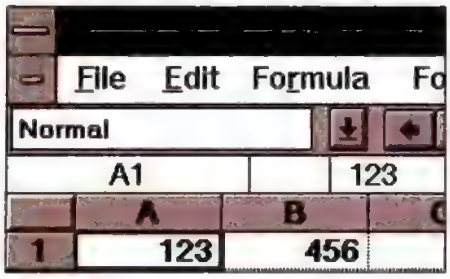
25-character text display.)

Because the whole purpose of a modem is to communicate with other devices, they must all speak the same language by following standards. You need to know about three standards, most of them established by the CCITT (Comite Consultatif International Telegraphique et Telephonique):

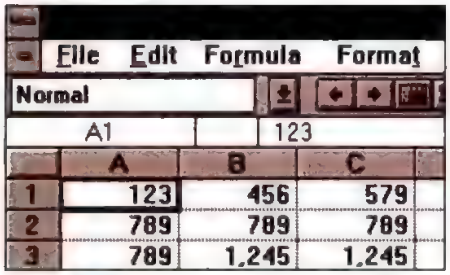
- Modulation/speed. These include *V.22bis* for 2,400 bps, *V.32* for 9,600 bps, and *V.32bis* for 14,400 bps. Faster modems typically incorporate earlier signaling standards. The difference between V.32 and V.32bis is more than just 4,800 bps of speed. V.32bis incorporates a number of fallback modes to 12,000, 9,600, 7,200, and 4,800 bps, while V.32 falls back only to 4,800 bps. This allows the V.32bis modem to operate at higher speeds on marginal telephone lines. V.32bis also has a *fall-forward* feature, meaning it tries to return to a higher speed if line quality allows. Once V.32 falls back, it stays there.
- Error correction. Microcom Networking Protocol 4, or *MNP 4*, was a de facto standard for many years. It has been supplanted by the CCITT V.42 standard. Most V.42 modems also include MNP 4 for compatibility, so a V.42 modem will handle MNP 4 (but not vice versa).
- Data compression. Here, too, a de facto standard, *MNP 5*, is giving way to

▪ Monitors: *Match Screen Size to Resolution*

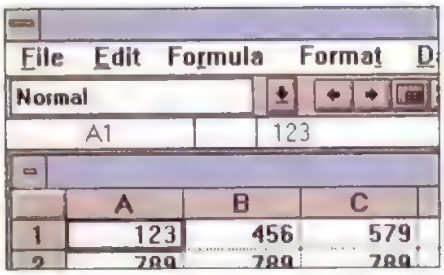
Actual size of characters



VGA (640-by-480)



Super VGA (800-by-600)



1,024-by-768

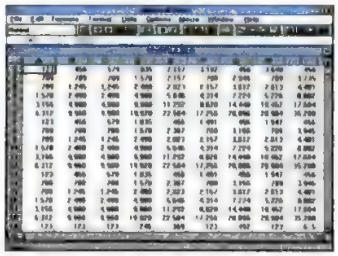
Getting more visual information on your screen serves no purpose if you can't read it. Because a Super VGA display shows about 60 percent more information than a VGA monitor, its characters are 20 percent smaller. Likewise, a 1,024-by-768 display holds 2.6 times the information of a VGA display, and the characters are 37 percent smaller.

You can compensate for these differences by using a larger monitor: VGA on a 14-inch monitor, Super VGA on a 17-inch monitor, and 1,024-by-768 on a 19-inch monitor produce similar-size characters.

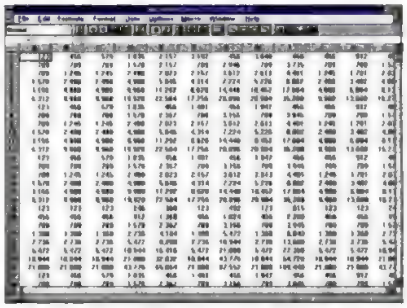
The images to the left show the actual sizes of characters in a Microsoft Excel spreadsheet under VGA, Super VGA, and 1,024-by-768 resolutions.

The images to the right show the amount of information visible on an Excel spreadsheet under VGA, Super VGA, and 1,024 resolutions. Increasing the size of the image keeps the characters roughly the same size in each of the three frames.

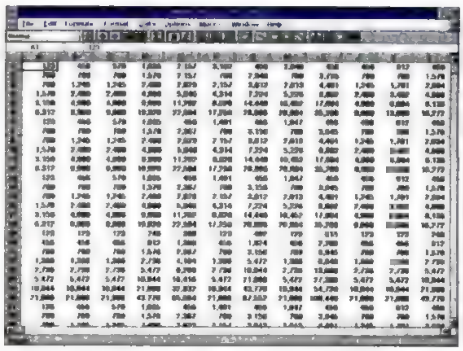
Amount of information



VGA, 14-inch screen



Super VGA, 17-inch screen



1,024-by-768, 19-inch screen

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CIRCLE 311 ON READER SERVICE CARD

CCITT V.42bis. V.42bis incorporates MNP 5 as a fallback compression method, and the V.42 error-correction standard as well. That means if you buy a V.42bis modem, it automatically has V.42 error correction. V.42bis allows for data compression approaching 4:1, while MNP 5's limit was on the order of 2:1, and MNP 5 actually increased the size of files previously compressed by a software program such as PKZIP.

Microcom continues to push its MNP standards and recently introduced MNP 10, which may have some potential for reliable cellular data communications. MNP 10 coexists with CCITT standards.

BEST BET: 9,600 OR 14,400 BPS

Today, you have no reason to consider a modem that operates slower than 2,400 bits per second; 9,600 bps is often an even better choice, given falling prices (typically between $300 and $500) and improving reliability of modems at that speed. The wide availability of inexpensive 2,400-bps modem chip sets from a variety of manufacturers has brought prices down below $100 in many cases. There is very little new technology, and because of the great similarity of products, *PC Magazine* will not be reviewing the category again. (Our last review, "2,400-bps Modems: Affordable Access," appeared in the March 26, 1991, issue.)

While you can expect to plug in a 2,400-bps modem and have it work flawlessly, the same has not been entirely true at higher speeds. When *PC Magazine* last tested top-of-the-line modems ("Maximum Modems: 14,400 bps and Rising," March 17, 1992), we discovered them to be sensitive to telephone-line quality and uneven in their compatibility among the products of different manufacturers. Moreover, most PCs proved unable to take advantage of their high communication rates. Most serial communications software tops out at 38,400 bps. The port drivers for Windows and OS/2 stop at 19,200 bps. To avoid dropping characters during disk access, many communications programs signal modems to slow down with hardware handshaking, further degrading communication speed. For faster communications, make sure your PC has a high-speed serial port controller, the *16550 UART,* rather than the older *8250.*

Of the ten modems we tested, we found only one that worked with all products and under all conditions: the $1,595 AT&T Comsphere 3810. Our second choice was the $699 Intel 14.4 EX, the only other product that allowed for a 57,600-bps connection. Note that this review was early in the life cycle of V.32bis modems and reliability and compatibility have improved markedly since then, and prices have fallen below $500 list for many more modems.

Although higher modem speeds may be realized in the future (the next standard, V.fast, reaches the theoretical speed limit for dial-up lines, 19,200 bps), digital telephone services such as ISDN (Integrated Services Digital Network) will make today's modems obsolete. About half the businesses in the country are scheduled to have access to ISDN by the end of 1994. A V.32bis modem may be the last modem that you buy, though you may want to wait a while until setup and operation become more routine.

Virtually all modems conform loosely to command-set standards laid down by Hayes in the 1970s (ATDT means "Attention, dial the following telephone number."), although implementations vary so much that it is helpful if your communications software recognizes your specific modem brand.

FAX MODEMS

Fax modems follow their own standard because they need a high-speed link in only one direction. (V.32 and V.32bis provide two-way top-speed communications.) Some 2,400-bps modems advertised with 9,600-bps fax capabilities have intriguing prices, but they won't communicate with V.32 services. If you buy a data/fax modem at an attractive price, it's probably 2,400-bps data, 9,600-bps fax.

Because it costs only a few dollars to add Group III fax capabilities (the same as on fax machines worldwide) to data modems, look for more combined data-fax modems, including an increasing number of external data-fax modems.

If you haven't ever used a fax modem, you should keep these caveats in mind: Fax machines are always easier to use than fax modems unless you are a skilled user working from an electronic file. Fax modems do a better job sending than receiving. Windows-based fax software is superior to DOS-based software. *OCR (optical character recognition) software* can turn received faxes into ASCII text, but accuracy is still mediocre.

Manufacturers aim for two styles of touch—a hard click keyboard that gives positive tactile feedback or a soft-touch keyboard that critics call "mushy" keyboards.

The choice between internal and external modems is mostly one of cost and convenience. Without the need for case or power supply, internal modems are uniformly less expensive. "Idiot" lights on external modems allow you to monitor their operation, which can be important in getting a high-speed modem to work. Although an external modem requires you to give up a serial port, an internal modem will steal a serial port allocation inside your PC.

Either way, you have to be careful about the port assignment given to your modem. Ports COM1 and COM4 share an interrupt (IRQ4), as do COM2 and COM3 (IRQ3). If an internal or external modem shares an interrupt with another serial device that is active at the same time, the result can be communication errors or even a system crash. You'll have to do the thinking when you set up your system to avoid conflicts. □

ALAN M. STOUGHTON IS A PC MAGAZINE LABS PROJECT LEADER FOR THE PCs TEAM. WINN L. ROSCH IS A CONTRIBUTING EDITOR TO PC MAGAZINE.

INTRODUCING AFFORDABLE COMPUTERS FROM THE COMPANY THAT'S ALWAYS STOOD FOR MORE THAN AFFORDABILITY.

THE COMPAQ DESKPRO/i. SO A LIMITED PRICE LEADS

The company most qualified to advance the state of the desktop computer announces four systems that represent a breakthrough in R&D. At prices that won't ruin your P&L. Reflecting the level of thinking and quality that you've come to expect from Compaq.

At Compaq, there's a fundamental belief held by all of us that when you set extraordinary goals, extraordinary people will meet them.

Recently, for example, you made it clear to us that you wanted new PCs, with everything from advanced graphics to audio capability to affordable prices. Our response: the COMPAQ DESKPRO/i Family of PCs. Four new systems loaded with features to enhance productivity.

The built-in COMPAQ QVision 1024 Graphics Controller, for example, allows you to scroll, resize windows and pull down menus up to ten times faster than most popular video graphic subsystems. So quickly, as a matter of fact, you may find your computer waiting for you. Instead of the other way around.

Its unique processor upgrade path ensures that your PC won't be swept into obsolescence.

Simple chip upgradability and a 64-KB cache

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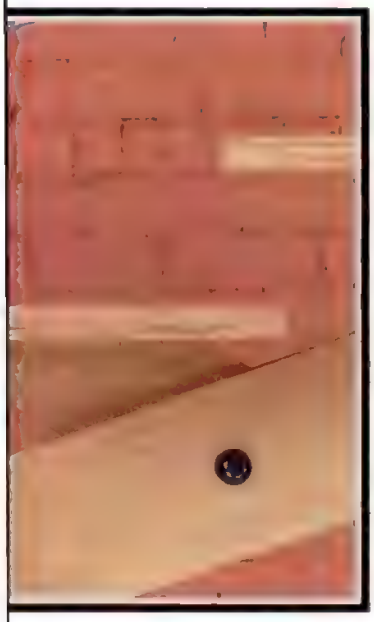
© 1992 Compaq Computer Corporation All Rights Reserved Printed in the U.S.A. COMPAQ DESKPRO Registered U.S. Patent and Trademark Office QVision and

MUCH FOR THE IDEA THAT TO LIMITED THINKING.

memory module option provide quantum leaps in performance. Without

Intel 386/25, 386/33, 486SX/25, 486/33 ◆ *QVision accelerated graphics* ◆ *Chip upgradability* ◆ *Integrated business audio* ◆ *4 MB RAM (expandable to 32 MB)* ◆ *Cache memory standard* ◆ *3 ISA expansion slots* ◆ *3 drive bays* ◆ *84-MB to 510-MB hard drive options* ◆ *Multi-level security features* ◆ *Microsoft MS-DOS 5.0 as published by Compaq*



similar outlays of cash.

The fully integrated audio system brings an unprecedented, yet not unfamiliar dimension to mainstream business computing: your voice. The result of a collaboration between Compaq and Microsoft, it allows you, among other things, to actually paste voice messages into spreadsheets and documents. Either as notes to yourself or as voice-mail across your entire network.

And we've engineered this breadth of technology right onto the PC's system board, preserving the small footprint, large storage capacity and expansion of the COMPAQ DESKPRO/i.

Not to mention your financial integrity.

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For more detailed information, just call us at 1-800-345-1518, ext. 210 in the U.S., or call us at 1-800-263-5868, ext. 210 in Canada.

We bet you'll be as excited about the COMPAQ DESKPRO/i as we are.

In scrolling, window resizing and accessing menus, our new QVision accelerated graphics beat the competition by as much as 10 to 1.

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OUR NEW NOTEBO MILLION BUCKS. WHICH C MISLEADING

Recently, our engineers set out to create a remarkably different notebook computer. With all of the quality, durability and features that you need. All at a sensible price. The result, as you can plainly see, is a remarkably different notebook. The new COMPAQ Contura PC.

One of the best things to happen to notebook computing since the fold-down airline tray table, the COMPAQ Contura Family of notebook PCs sets the standard for what an affordable notebook ought to be.

Just beneath its sleek, ergonomic styling lies the rugged, well-tested, well-thought-out PC you expect from Compaq.

No substandard parts

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OK PC LOOKS LIKE A OULD MAKE THIS THE MOST AD IN HISTORY.

or components. No second-rate manufacturing. No logos stuck on the outside after somebody else's guts went inside.

Thanks to high levels of chip integration and some of the smartest mechanical design this side of NASA, we've managed to engineer costs out and the right stuff in.

Intel 386SL/25 with 64-KB cache ◆ 4 MB RAM (up to 12 MB) ◆ 60- or 120-MB hard drive
Intel 386SL/20 ◆ 2 MB RAM (up to 10 MB) ◆ 40- or 84-MB hard drive ◆ Both models: 6.2 lbs. ◆ 9.5" VGA display ◆ Isolated inverted "T" cursor controls ◆ 3.5-hr. NiCd battery (optional NiMH battery) ◆ Microsoft MS-DOS 5.0 as published by Compaq

Open either COMPAQ Contura PC and you'll find a large, 9.5-inch screen beaming brightly.

Lay your fingers on the keyboard and they immediately feel at home.

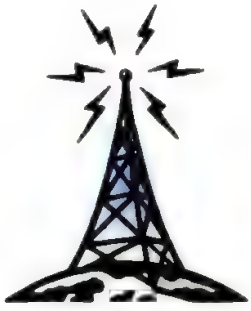
This notebook also has a unique ability to hibernate when left idle, saving all open files to the hard drive and automatically shutting your notebook down. Preserving your remaining battery life. Start up hours, days, or even years later, and you're right where you left off.

In addition to all of the above, the COMPAQ Contura notebook PCs support three internal power-conserving modems from Compaq.

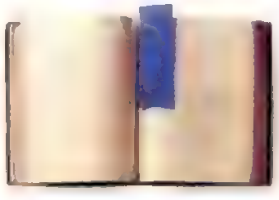
All of which is backed by CompaqCare, our new service and support program, which includes a free one-year limited warranty good anywhere in the world. And free on-site* service anywhere in the U.S. and Canada.

For information, call 1-800-345-1518, ext. 220 in the U.S., or call 1-800-263-5868, ext. 220 in Canada.

We'll tell you more about it. We'll tell you all the places you can get it. And we'll tell you that you won't find an affordable notebook PC that looks this good and works this well no matter who you call.



Just because you're out of the office doesn't mean you're out of touch. The COMPAQ Contura PC features an optional power-conserving 2400-bps data/9600-bps fax modem.



As well as a uniquely sophisticated power conservation tool, Hibernation also serves as an easy-to-use placemark.

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AN INEXPENSIVE PC THA FROM THE COMPANY T

What happens when the best computer engineers in the world design a low-priced desktop PC? You get the new COMPAQ ProLinea Line of PCs, perhaps the best value PCs in the world. What happens when a clone maker designs a low-priced PC? You get what you pay for.

When Compaq engineers set out to build an affordable, full performance desktop PC with all the essential features, there were a lot of options to choose from.

We could have bought an existing low-end computer company.

We could have farmed out all manufacturing.

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But then all we would have ended up with is simply another inferior,

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low-priced clone. And what we wanted was a low-priced COMPAQ computer.

Which is what you told us you wanted.

So through some high levels of chip integration and some equally high levels of engineering, design and just plain common sense, we've cut costs in system design and manufacturing.

While still managing to deliver 100 percent of the virtues you've come to expect from Compaq.

You can choose from three different models, opting for either Intel 386SX/25 or 486/33 processing power.

So whether it's expansion, storage, processing speed or a small footprint that you're most concerned with, there's a model perfectly suited to your needs.

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Most importantly, the new COMPAQ ProLinea PCs are backed not only by the assurance of the COMPAQ name, but also by CompaqCare, our new service and support program. Which includes a free one-year, on-site* limited warranty, and a host of other services.

And to go along with our new line of PCs, there's a whole new line of places you can find them. Give us a call for more details.

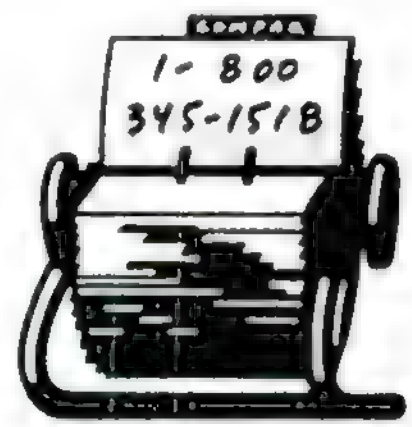
In the U.S., call us at 1-800-345-1518, ext. 215, and in Canada, just call 1-800-263-5868, ext. 215.

We think you'll be pleasantly surprised at exactly how much the COMPAQ ProLinea PCs have to offer.

And equally surprised by how little we're able to offer them for.

Intel 386SX/25 ◂ *small footprint* ◂ *2 MB RAM* ◂ *2 ISA slots* ◂ *2 drive bays* ◂ *40- or 84-MB hard drive*
Intel 386SX/25 ◂ *2 MB RAM* ◂ *3 ISA slots* ◂ *3 drive bays* ◂ *84- or 120-MB hard drive*
Intel 486/33 ◂ *4 MB RAM* ◂ *3 ISA slots* ◂ *3 drive bays* ◂ *84- or 120-MB hard drive*
All models include high-resolution 1024 x 768 video and pre-installed Microsoft MS-DOS 5.0 as published by Compaq

All in all, the COMPAQ ProLinea 3/25zs PC sizes up quite nicely. At a mere 12.6" x 14.9" x 3.5," it's one of the smallest footprints in the industry.



All of our models are backed by CompaqCare, our comprehensive new service and support program. For details, just call 1-800-345-1518.

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AFFORDABILITY RUNS DEEP.

Affordable prices aren't limited to our new products. In fact, we've lowered suggested list prices by up to 40% on COMPAQ hardware. And even more on our list of options.

In the past twelve months at Compaq, we've incorporated major efficiencies in design, engineering and manufacturing across our product line.

As a result, you'll notice savings on everything from our notebook PCs to our desktop computers to our servers to our extensive list of optional equipment. The right computer at the right price.

The following list includes just some of the COMPAQ products that are now more affordable. Obviously, when it comes to the subject of affordability, we could go on and on. But we'd rather talk to you directly.

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PORTABLE 486c Model 120 ◂ PORTABLE 486c Model 210 SLT 386s/20 Model 60 ◂ SLT 386s/20 Model 120 ◂ LTE Lite/20 Model 40 ◂ LTE Lite/20 Model 60 ◂ LTE Lite/20 Model 84 ◂ LTE Lite/25 Model 60 ◂ LTE Lite/25 Model 84 ◂ LTE Lite/25 Model 120 ◂ LTE 386s/20 Model 30 ◂ LTE 386s/20 Model 60 ◂ LTE 386s/20 Model 84

SYSTEMPRO/LT Model 486-SX/25-210 ◂ SYSTEMPRO/LT Model 486SX/25 510◂ SYSTEMPRO/LT Model 486SX/25-680 ◂ SYSTEMPRO/LT Model 486/33-210◂ SYSTEMPRO/LT Model 486/33-510 ◂ SYSTEMPRO/LT Model 486/33-1020 ◂ SYSTEMPRO 486/33-420 ◂ SYSTEMPRO 486/33-840 ◂ SYSTEMPRO 486/33-2040

40-Megabyte Hard Drive ◂ 60-Megabyte Hard Drive ◂ 84-Megabyte Hard Drive ◂ 120-Megabyte Hard Drive ◂ 210-Megabyte Hard Drive ◂ 340-Megabyte Hard Drive ◂ 510- Megabyte Hard Drive ◂ 240-Megabyte Drive Array Pair ◂ 420-Megabyte Drive Array Pair ◂ 680-Megabyte Drive Array Pair ◂ 1.02-GB Drive Array Pair ◂ 1-Megabyte Memory Module ◂ 2-Megabyte Memory Module ◂ 4-Megabyte Memory Module ◂ 8-Megabyte Memory Module ◂ 2-Megabyte Single-Socket Memory Module ◂ 8-Megabyte Single-Socket Memory Module ◂ 32-Megabyte Dual-Socket Memory Module ◂ 1.3-GB Differential Interface Hard Drive....

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CIRCLE 137 ON READER SERVICE CARD

THERE ARE TWO PLACES WHERE COMPLEX NETWORK INTEGRATION PROBLEMS CAN BE WORKED OUT.

YOUR PLACE.

As surprising as it may seem, there are many clone companies that boost profit margins by not hiring enough designers and doing dangerously little testing. What does it all mean? It means that your network is the unofficial test site for their server.

Introducing the design and testing engineers of our Systems Division at Compaq headquarters in Houston, Texas.

These are the same people who built our reputation for developing the servers of choice in the computer industry.

In fact, in a recent survey, the readers of *LAN Times* selected COMPAQ 386- and 486-based file servers over all others – IBM, Northgate, Dell and AST included – for the second year in a row.

Becoming this good requires months of rigorous network testing. This process – which we believe has no equal in the entire PC server industry – is referred to affectionately as "The Meat Grinder."

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OR OURS.

Virtually every kind of test is run using literally hundreds of different applications, configurations and cards. Running on the world's four most popular network operating systems.

But to be perfectly honest, not all development and testing takes place at our place.

Because the engineers at Novell, SCO, Microsoft and Banyan—in long-standing technical alliance with Compaq—work to make sure you get both the easiest integration and highest performance possible.

Unfortunately, those engineers were unable to make it to the above photo session.

Nor could the specialists who created the COMPAQ ToolKits and TechNotes—the industry's most sought-after guides for multi-vendor network integration.

Or the thousands of technicians who provide you with a full year of free, on-site service.*

Or the experts who staff our free technical support line, resolving 95% of your questions in 15 minutes or less.

For more information about everything Compaq has to offer, just call. 1-800-345-1518, ext. 200 in the U.S.A.

And in Canada call 1-800-263-5868, ext. 200.

When it comes to PC server-based computing, you'll see there's really only one place to go.

The new enhanced COMPAQ SYSTEMPRO models feature the latest drive array controller, dramatically increasing I/O throughput.

The COMPAQ Server Manager/R lets you monitor and diagnose your server remotely. In the event of a problem, it calls your beeper—preventing any downtime before it happens.

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THE ULTIMATE OPTICAL OPTION.

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Think of it as an erasable drive, as accessible as the hard drive on your personal computer, but with the capacity to process and store huge files, and the option of removability for convenience and security.

Or think of it as a WORM drive with all of the archival permanence that makes WORM perfect for many applications.

THE WORLD'S FIRST MULTIFUNCTION OPTICAL DISK DRIVE.

So you won't have to buy a new disk drive just because your needs change. That's why the Pioneer multifunction disk drive will never become a dinosaur. It'll always be a reliable workhorse. You can't beat that option.

For more information, call 1-800 LASER ON. Ask for product literature or a free electronic brochure (for MS-DOS machines with 5¼" high-density drives) and find out why Pioneer is the leader in optical technology.

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CIRCLE 312 ON READER SERVICE CARD

THE WELL TUNED PC

A Guide to Memory Management

Even the hottest PC can be thwarted if system resources (memory and disk space) are used inefficiently. We'll show you how to create a finely tuned machine using all the tricks of modern DOS memory management.

Optimizing your PC may sound like a highly technical or deeply mystical quest. In reality, optimization is no more than the practical process of customizing your system so that its resources are used most effectively. In the DOS world, this usually involves editing your CONFIG.SYS and AUTOEXEC.BAT files, tailoring them to fit your system configuration. For users of 386, 486, and some 286 systems, it also means taking full advantage of your computer's memory management capabilities.

Many think of optimization as tuning the system—like you would with a racecar engine—to coax the greatest possible speeds. But, to continue the automotive analogy, racing is a highly specialized activity that few of us pursue. Speed is important to any PC user, of course; all things being equal, the more speed the better. But to the extent that there is a trade-off between speed and system resources, resources often turn out to be at least as important. Whenever you install a software disk cache, for example, you face a decision about the relative importance of speed and resources. How large should the cache be? How much memory can you afford to sacrifice?

SIMM CHIP
You can add more 1MB RAM chips like this, or read the following and learn memory optimization.

When it comes to both cars and computers, most of us aim for reliable long-term operation rather than sheer speed; we want everything working smoothly, with a minimum of breakdowns. The well-tuned PC achieves a balance among processing speed, available memory, disk space, and stability.

VARIABLE COMPLEXITY

The optimization process is as complex as the number of variables it encompasses. Even if all you want to do is increase the amount of conventional memory available to application programs, you must first create upper memory space, then load device drivers and TSRs (terminate and stay resident programs or "pop-up" software) into the upper memory areas. The more complex your system is, the more complex the process becomes. Factors include the number and size of the programs you want to load high, whether or not the load order is important, and whether your efforts introduce memory conflicts.

by Rick Ayre and Laura Cox

As with an automobile tune-up, you adjust the balance of your computer system depending on how it's equipped, how you intend to use it, and what resources you have at your disposal. As a point of departure, you must have enough conventional memory available to run your most memory-hungry application. (For a detailed discussion of the different types of DOS memory, refer to "The Ultimate Tricksters: How DOS Memory Managers Work" at the end of this section.) But some applications need expanded memory to work efficiently or to work at all; others may need extended memory. FoxPro, for example, runs significantly faster when either expanded or extended memory is available.

To complicate matters further, most of us don't use our PCs in the same way all of the time. We use different applications with different memory requirements. So today, the meaning of memory management clearly transcends the mere recovery of conventional memory, and encompasses the dynamic allocation of *all* kinds of memory—extended, expanded, and conventional—as quickly and effectively as applications demand it. Luckily, computer software is getting smarter, and much of it, including memory managers, can handle the dynamic process of optimizing for constantly changing needs.

ATLast!: The Lazy Person's Solution To Upper Memory Management

by Lenny Bailes

The $79 ATLast!, from RYBS Electronics, is designed for people who hate PC memory management software. It analyzes your system configuration and loads programs above 640K after just one reboot. You don't have to add anything manually to your CONFIG.SYS or AUTOEXEC.BAT files, and ATLast! works without littering these files with LOADHIGH and DEVICEHIGH statements. If you add or remove programs from your CONFIG.SYS or AUTOEXEC.BAT files, ATLast! automatically detects this, reboots the machine once, and rearranges the remaining drivers in upper memory.

ATLast! is a flexible utility that works with any MS-DOS version from 3.3 to 5.0, with DR DOS 6.0, and with dedicated 386 memory managers like QEMM-386, 386MAX, and NetRoom. ATLast! also works on 8088-, 8086-, or 286-based PCs equipped with NEAT shadow RAM or third-party EMS 4.0 expansion cards. RYBS sells a 256K "upper memory card" for 8088-, 8086-, or 286-based PCs that don't have NEAT chip sets or EMS 4.0. The company also manufactures a card that supports upper memory and expanded memory for IBM PS/2 Micro Channel machines.

Make no mistake: ATLast! is *not* an expanded memory manager. It requires a preexisting EMS 4.0 manager on the system to manage upper memory. (On 386-based systems, the HIMEM and EMM386 modules included with Microsoft Windows 3.0 and 3.1 work fine.) The installation procedure, however, is painless. ATLast! scans all the drives on your system for occurrences of HIMEM.SYS/EMM386.EXE or for the DR DOS HIDOS.SYS/EMM386.SYS. The program pops up an MS-DOS 5.0– or DR DOS 6.0–specific configuration menu, depending on which operating system it finds on your hard disk. The menu allows you to override ATLast!'s automatic defaults, but this probably won't be necessary. ATLast! scans upper memory and suggests optimal parameters for the EMM386 command line. If EMM386 is already loaded in memory, ATLast! asks if you want to preserve the current configuration, or remove EMM386 from the CONFIG.SYS and start over.

If ATLast! finds an EMS 4.0 memory manager other than EMM386.EXE or EMM386.SYS installed, it preserves the existing settings, passing them along to the ATLAST!.EXE upper memory manager. If you haven't removed the LOADHI helper statements from CONFIG.SYS and AUTOEXEC.BAT, you may quit the installation program and do so. Once the LOADHI helpers are removed, ATLast!'s setup program will reboot the system once and then optimize upper memory usage. No additional commands are inserted into CONFIG.SYS and AUTOEXEC.BAT.

You may subsequently add or delete commands in AUTOEXEC.BAT and CONFIG.SYS without worrying about upper memory. (ATLast! also reads any nested batch files called from the AUTOEXEC.BAT.) If the startup configuration changes, ATLast! detects this, reanalyzes the configuration, and rearranges the programs loaded in upper memory. In many configuration situations, ATLast! may prove faster and more efficient than the upper memory optimizers bundled with dedicated 386 memory managers. On tests with Quarterdeck's QEMM-386,

FACT FILE

ATLast!, Version 6.07

RYBS Electronics Inc., 2590 Central Ave., Boulder, CO 80301; 303-444-6073; fax 303-449-9259

List Price: $79. **Requires:** 1MB RAM, DOS 3.3 or later. (For UMB support, at least 640K and an EEMS/EMS 4.0 memory manager or NEAT/LEAP chip set with shadow RAM. For HMA support, a 286-based PC or better with at least 64K of extended memory.)

478 ON READER SERVICE CARD

CHOICES

With today's DOS memory managers, you'll have to make some basic optimization decisions, but they are likely to be very general decisions—more about style than substance. For example, you have to decide if you need true multitasking (processing one application in the background while you work in another) or whether task swapping (moving quickly among several open applications without background processing) will better serve your needs. If the answer is true multitasking, then for the moment, in the DOS world, you will probably be choosing between the DESQview and Microsoft Windows environments. If the choice is Windows, you'll need to decide if you want to run primarily Windows applications, or use DOS applications under Windows. If the answer is task swappers, you need to decide if the MS-DOS Shell will meet your specific needs or if you need to move beyond that to a third-party program like Software Carousel, from SoftLogic Solutions.

The answers you give to these kinds of questions will dictate how you go about optimizing your PC. As you work through the process, you may encounter memory conflicts, poorly behaved device drivers, and unruly TSRs. Our guide to the perfectly optimized PC will help shepherd you through those hazards.

Version 6.02, ATLast! preserved 10K more conventional memory than Quarterdeck's Optimize.

The amount of upper memory AtLast! makes available is determined by the EMS manager used in conjunction with it. If you use QEMM with Stealth, the upper limit is around 225K. With MS-DOS 5.0's EMM386, it will vary from 64K to 160K, depending on BIOS, peripherals, and the judicious use of INCLUDE statements.

HAND TWEAK

Users who have some familiarity with memory management techniques may customize ATLast!'s performance by manually editing the settings in the ATLAST!.INI file (stored in the ATLast! directory). The installation procedure watches for software that might cause incompatibilities when loaded high (such as AddStor's SuperStor disk compression drivers). In some cases, the user may obtain more conventional memory by manually shifting the position of the EMS 4.0 manager in the CONFIG .SYS, but this is generally not necessary. ATLast! is designed to be as transparent to the user as possible.

Although ATLast! is pretty reliable, the user may have to intervene and fine-tune certain problem configurations:

1. Delayed-write disk caches such as HyperDisk and Super PC-Kwik need to have their advanced write feature turned off in order for ATLast! to recognize successfully changes in the startup configuration and correctly reboot the system. Users of the SMARTDRV cache bundled with Windows 3.1 must remove any "double-buffering" statement loaded in the CONFIG.SYS. RYBS is aware of these limitations, and intends to fix this problem in the next shipping version.

2. You must manually check the AUTOEXEC.BAT for certain utilities that take over the keyboard. For instance, ATLast!'s automatic reboot/reconfiguration process fails if The Norton Utilities NCC command is invoked to display the system date and time. This problem can be solved by manually entering the statement [d:]\ATLAST!\ATLAST! directly before any "problem" utility in the AUTOEXEC.BAT (that is, prior to a statement like

```
[d:]\NORTON\NCC /START).
```

3. With QEMM-386's Stealth parameter turned on, and a low EMS page frame, ATLast! may hang the system when trying to load certain device drivers, even simple ones. Setting the EMS page frame to E000 solves this problem. The ATLAST!.INI file can also be edited to force "problem drivers" to load into conventional memory.

An ATLast! network site license reduces the cost per workstation for large corporate environments. The package may save MIS managers much time, since it minimizes the need to tinker with individual workstation configurations each time a new program is added to the system.□

MULTITASKERS AND TASK SWITCHERS

Multitaskers and task switchers differ in one important way: Multitaskers (DESQview and Windows, for example) keep all open applications running at once, while task switchers (like Software Carousel and Headroom) allow you to move directly among several open applications, but freeze all except the foreground program.

HOW TO FREEZE BACKGROUND APPS

Multitaskers keep background programs running by sharing CPU cycles among the various apps. Because of this sharing, active background applications slow the operation of the foreground application. The more apps that are open, the slower the foreground program will run. If you use a multitasking environment but don't really need your programs running all the time, set up your applications so that they are frozen when switched to the background. In Windows, use the PIF Editor to create or modify a PIF for each app you want to use in this way. To turn off background execution, just leave the check box "Execution: Background" empty.

ELIMINATING RAM HOG

Left to its own devices, the DOS 5.0 task switcher gobbles up all available memory when you run it. But it can allocate only XMS memory to programs running under it. As a result, programs that need EMS memory or VCPI-compliant extended memory are out of luck. The only way around this dilemma is to limit the amount of memory the task switcher can grab. With most memory managers, you can do this by adding a switch to the command line that loads the device driver in CONFIG.SYS. If you are using DOS 5.0, for example, and load the HIMEM.SYS device driver, you need to use the /INT15=*xxxx* switch, where *xxxx* is the amount of memory you want to make available to the task switcher.

GETTING DOWN WITH MEMORY MANAGERS

In an ideal world, memory managers would be invisible. You'd just put a disk in your floppy disk drive, type A:INSTALL, and the software would copy files to your hard disk, and optimize memory. Unfortunately, that's not the way it happens in the real world—at least not often. Today's memory managers will try to optimize, and, if you're lucky, cause you no grief. How close they come depends to a large extent on how complicated your system is and how much demand there is for memory resources.

If you have a plain-vanilla computer and all you need to do is load a few small TSRs (like DOSKEY) and device drivers (like MOUSE.SYS), the better memory managers will do that for you automatically—no muss, no fuss. If, on the other hand, your system is loaded up with a network interface card, a CD-ROM, and a few other TSRs and drivers, then it's unlikely that you'll get an optimum setup from any automatic or interactive install program. This is a shame, because the most complicated systems are the ones that need memory managers most.

We began our quest for the perfectly optimized PC by rounding up the three products awarded the *PC Magazine* Editors' Choice in the past two years: Helix Software's NetRoom, Quarterdeck Office Systems' QEMM-386, and Qualitas's 386MAX. We then challenged the contenders by turning them loose on a couple of tough system configurations—configurations our readers tell us are typical of real-world computer use. Our intent was not so much to push these programs to their limits as to judge their readiness for the real world our readers inhabit. The test systems are described in detail, below.

Our first phase of testing involved simply accepting each package's default, install-routine solution. We next reinstalled each program, selecting configuration options that seemed appropriate. Finally, we invited the vendors to come to PC Maga-

CREATING THE ULTIMATE MEMORY MAP

Some people believe the memory management challenge is to create as much upper memory as possible. Actually, the real challenge is to create exactly as much upper memory as it takes to load your drivers and TSRs high—and no more. Remember that upper memory is extended memory that's mapped into the upper memory region (between 640K and 1,024K). Any upper RAM you create in this manner but don't use is memory wasted. If left as extended memory, it can still be used by any program that can access XMS memory. If you use DESQview as your multitasker, however, you don't need to worry about mapping too much upper memory. DESQview is smart enough to optimize upper memory use. If, on the other hand, you use Microsoft Windows, map only as much upper memory as you need.

Our Contributors: EDWARD MENDELSON and JEFF PROSISE are contributing editors to *PC Magazine*. RICK AYRE is the PC Magazine Labs project leader for the software team. LAURA COX is a support technician of PC Magazine Labs. LENNY BAILES is a frequent contributor to *PC Magazine*.

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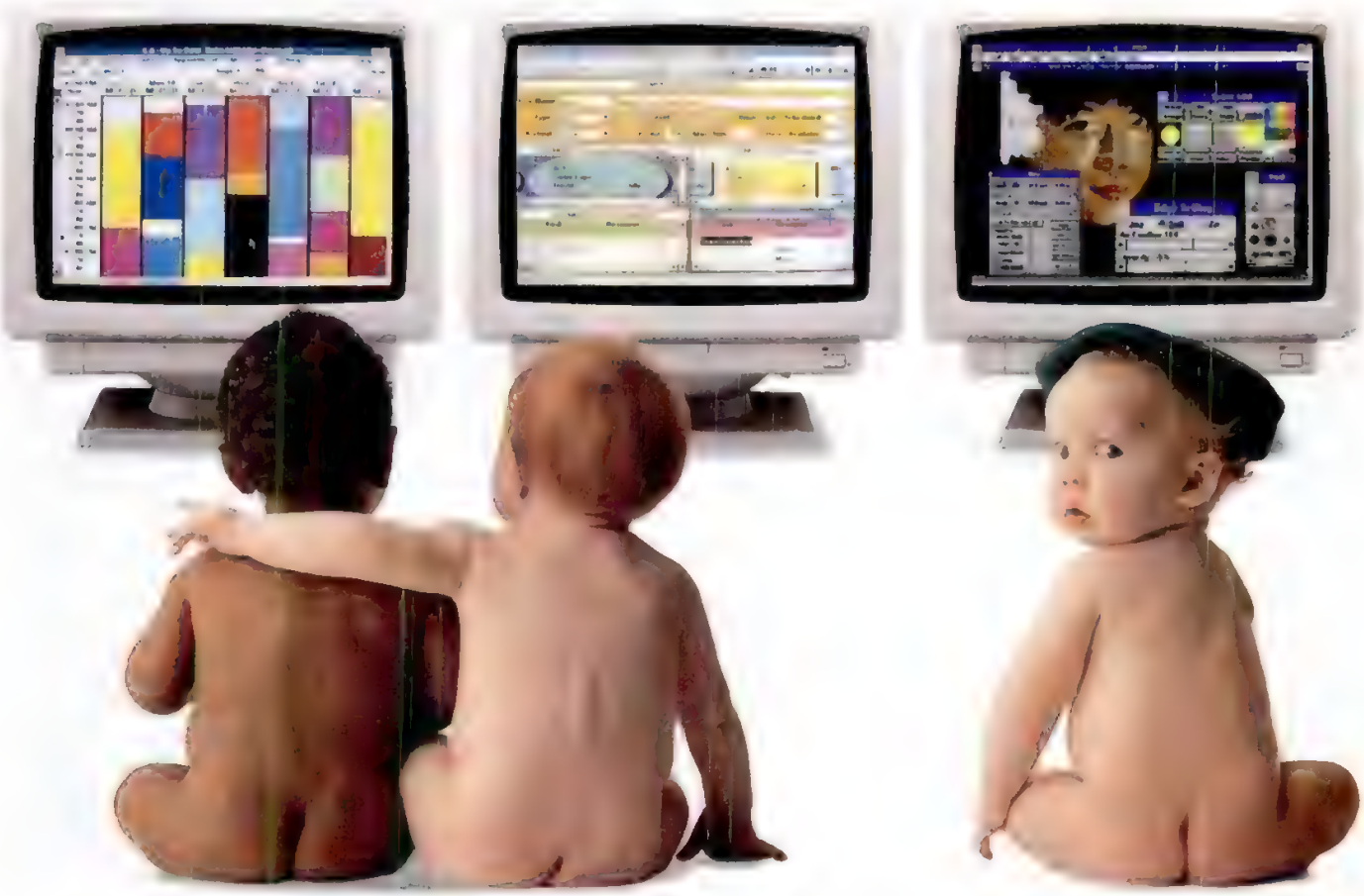

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CIRCLE 348 ON READER SERVICE CARD

Give Your Memory Manager Less to Manage: *Unloading Device Drivers*

by Edward Mendelson

At one time, your CONFIG.SYS file was slim and efficient, but now it's bloated with device drivers. These drivers run peripherals (mice, fax boards, scanners, RAM disks, and CD-ROM drives), add graphics capabilities to your system, intercept printer output, link your computer to a network, or perform any of a dozen other tasks.

Even though you probably use many of these drivers only once a day or once a week, they all consume RAM—all the time your computer is on. That means they waste RAM when they're not being used. Unfortunately, you can't easily clear device drivers out of memory. Nor can you unload drivers loaded from CONFIG.SYS in the same way you can unload most TSR (terminate and stay resident) programs that you run from AUTOEXEC.BAT, other batch files, or the DOS command line.

You can change the drivers you install by keeping a collection of CONFIG.SYS and AUTOEXEC.BAT files on your disk and installing different ones and rebooting, or by using a utility such as the *PC Magazine* utility MBOOT, which lets you select different configurations each time you boot. But these "solutions" waste time and effort, and they don't let you unload drivers without rebooting.

SOME BETTER SOLUTIONS

Fortunately, you can find low- and no-cost utilities that let you load device drivers from batch files or the DOS command line, and then let you unload them afterward. If you use your CD-ROM drive once a week, you can write a batch file that loads its device driver and TSR software, runs the program you use to access the CD-ROM, then unloads the device driver and TSR when you're through. As a result, you don't waste RAM on a device driver when you don't need it.

FACT FILE

Dynamic Memory Control, Version 3.0

Adlersparre & Associates Inc., 1803 Douglas St., #501, Victoria, BC, Canada V8T 5C3; 604-384-1118; fax 604-384-3363

List Price: $79.95
Requires: 128K RAM, DOS 3.0 or later.

471 ON READER SERVICE CARD

The utility that manages device drivers most effectively is Adlersparre & Associates' $79.95 Dynamic Memory Control, Version 3.0. This program loads and unloads virtually any device that you normally run from CONFIG.SYS. It even loads and unloads Quarterdeck's QEMM-386, although it can't unload Qualitas's 386MAX.

PUTTING IT TO WORK

You use Dynamic Memory Control by creating small batch files that load a 1,600-byte housekeeping TSR, then one or more device drivers and TSRs. When you want to unload the device drivers and TSRs, you run another small program that clears out the memory. Options let you clear expanded memory used by the driver or TSR, or clear blocks of memory used by network drivers if the network software lacks its own utility to do the job.

Dynamic Memory Control works quickly and cleanly with every device driver I tried, letting me load and unload drivers for scanners, CD-ROMs, fax boards, and miscellaneous printer control software, among others. Dynamic Memory Control's method of using a housekeeper TSR followed by device drivers and other TSRs is similar to the long-established method used by Kim Kokkonen's free TSRCOM and *PC Magazine*'s INSTALL/REMOVE, two sets of utilities that load and unload TSRs but not device drivers. (You can find TSRCOM.ZIP in PC MagNet's UTILFORUM, Library 16; INSTALL/REMOVE is available as INSTAL.ARC in Library 2 of UTILFORUM.)

LIKES BOTH FLAVORS

Device drivers are either block drivers or character drivers. Block drivers, which include CD-ROM drivers and RAM disks, transfer data in the form of large blocks; character drivers, which typically include communications drivers and ANSI.SYS, transfer data as individual characters. Dynamic Memory Control manages both kinds of drivers.

If you only want to load and unload character drivers, you can use Rod Pullmann's free DEVICE.ZIP (available on CompuServe's IBMSYS, Library 1). This loads character devices effectively, but my system occasionally locks up after unloading them. You'll have to experiment with the devices you use, but it won't cost you anything to try.

Jim Kyle's DEVLOD.ARC (on CompuServe's DDJFORUM, Library 0) includes a small program to load character drivers from the command line, but doesn't include facilities for unloading. Similarly, the DEVICE.COM that comes with Quarterdeck's DESQview loads character drivers for use in a DESQview window, but doesn't unload them. □

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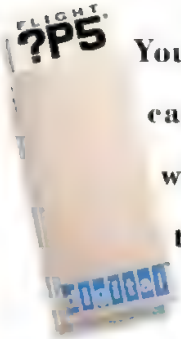

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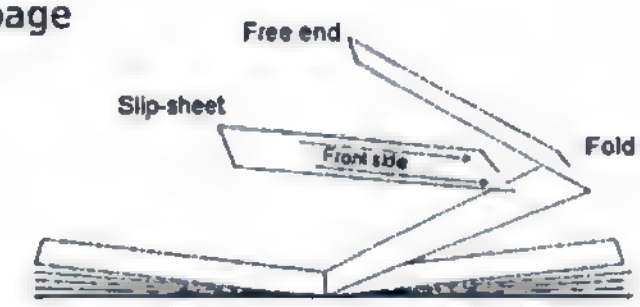

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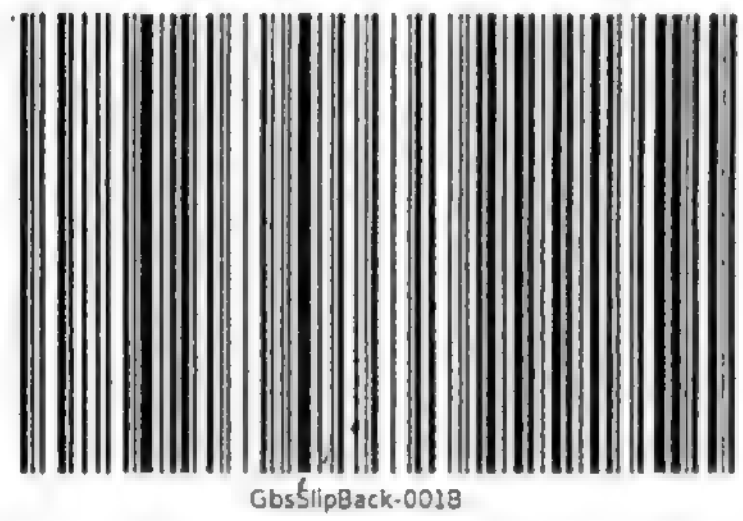

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i386 i486 ..... Other ... Not Sure
How many applications will your PC(s) run in a typical workday?
How many PCs do you anticipate purchasing over the next 12 months?.....
Are you interested in leasing? .....Yes ..... No
Immediately ..... 1 - 3 months
3 - 6 months ..... 6 - 12 months

What best describes the type of work the system will be used for? (Check all that apply)

- O Word Processing
- O Database (filing records)
- O Retail Store Management
- O Education
- O Engineering
- O Scientific Research
- O E-Mail
- O Order-entry
- O Financial Calculations
- O Desktop Publishing
- O Design (CAD/CAM)
- O Industrial Process Control
- O Software Development
- O Other industry-specific applications (please specify)

Which of these graphics-oriented applications best describes your needs? (Check all that apply)

O Desktop Publishing O CAD/CAM O Animation
O Realtime Modeling O Image Processing
O AutoCad O Business Graphics

How many people work in your group, department or small business?
O Less than 10 O 10-20 O 20-35 O More

Is your desktop operating system:
O DOS O DOS with Windows O OS/2
O MAC O UNIX™
O VMS O Other

LAN Communication:

How many PCs do you have installed?
From how many manufacturers?
What kinds of connections does your PC(s) require? (Check all that apply)

- O Links with other PCs in the immediate surroundings
- O Connection to the local area network (LAN) throughout a building
- O A line to a host system in a remote location

What kind of media (cable) is used in your LANs today?
What is the networking software now being used in your company?

What kind of host system will your PC communicate with?
O Digital O IBM O Other

What kind of service do you need?

O On-Site Hardware Support O Software Support
O Telephone Support O Training
O FAX Hotline

How many of your users take portables on the road?
Do you currently have a service contract(s) for your PCs?
O Yes O No
How many?
Does your service provider offer Multivendor Support?
O Yes O No

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zine Labs and tweak their own programs on each of our test systems. Predictably, our results improved as we moved from stage to stage.

This doesn't mean that to optimize your system you have to pester the developers in to supervise the job. What we discovered, when all was said and done, was that we had become experts—of a sort. If we can do it, so can you. Here's the 30-second overview of how you can become an expert, too.

The Technology. Come to grips with your computer's memory architecture (again, see the section "The Ultimate Tricksters: How DOS Memory Managers Work"); you really can't be any kind of expert until you do.

The Battle Plan. You are a lot more likely to win this war if you know, going into each battle, what you want to accomplish—which in most cases means nothing more than clearly defining what you would consider success. Ask yourself questions like, "How much conventional memory do I really need? Do I need EMS compatibility?"

The Specifics. When we finished our tests, we understood how to avoid many common pitfalls. If you follow the saga of our adventures in MemoryLand, you can at least avoid the perils we encountered.

The Moral. You can do it; yes you can. And it's well worth the effort.

USING TSRs AND TASK SWITCHERS

TSRs loaded before a task switcher are available to all applications you run under the task switcher, but they also reduce the amount of conventional memory available to each running application. Be clear about whether or not you need to access a TSR in every task session. If you do, then by all means, load it before you run your switcher. Otherwise, load it as a separate session—after you run the task switcher. You might want to load DOSKEY before, for instance, because you'll want it available on every command line. SideKick, on the other hand, is a TSR you might want to run in a session of its own. The same guidelines apply to TSRs in multitasking environments.

CHALLENGE #1: COMPAQ ON A NETWORK

Our first test system was chosen to typify the business desktop computer. It used to be that connecting your desktop computer to a network was a big deal—a real stretching of resources. Today, it's only the beginning. If you add multimedia capability, for instance, you also add a CD-ROM and a sound board, at minimum.

We chose a Compaq 386/25e, with a standard Compaq VGA display, 8MB of memory, and a 330MB hard disk. To this basic system we added a Western Digital Ethernet network device interface board, a Sony external CD-ROM, and a mouse. We loaded the computer with Compaq DOS 5.0, a mouse driver, the CD-ROM drivers and TSRs, the network drivers for Novell's NetWare 3.11, Super PC-Kwik (a popular software disk cache), as well as the small driver for SETVER and the small TSR, DOSKEY.

At baseline(testing-ese for *when we began*), we had about 461K of conventional memory available. (Throughout our discussions, when we refer to available memory, we mean what DOS 5.0's MEM.EXE program calls "Largest executable program size," when the "/c" switch, which provides detailed information, is used.) There would have been less, but we installed PC-Kwik using the "/e" option, which causes the program itself to be loaded into upper memory and the cache buffers into extended memory.

Using the interactive optimizing program that comes with each memory manager (386MAX's Maximize, QEMM-386's Optimize, and NetRoom's Customize in its Discover program), we were able to load many of the drivers and TSRs into high memory, thus recovering some conventional memory in each case. NetRoom did the best job of automatic optimization, making 548K available; QEMM-386 was nearly as efficient, giving us 546K; 386MAX made 523K of conventional RAM available.

Our next goal was to reclaim more conventional memory by using the interactive programs to change some of the default settings—the location of the EMS page frame, for example. All three programs gave us additional gains. On the average, about 590K of conventional memory became available when we took this approach.

Since the aggregate size of the programs still loaded in conventional memory was smaller than the block of upper memory that was still available, we felt we should be able to succeed in loading all the files high. Accordingly, we turned our attention to tweaking each system further by hand. This was done by changing the loading order of the files that we were trying to fit into upper memory.

USING MULTITASKERS AND COMM SOFTWARE

Asynchronous communications programs like Procomm are prime examples of applications that require lots of CPU attention. If, while running in a multitasking environment, such programs can't get processor attention on demand, they may abort a file transfer, drop a carrier in the middle of a communications session, or lose characters during ASCII transmissions.

A tip that may help is to provide alternate EMS maps. This is accomplished with a switch setting on the device driver line in CONFIG.SYS that loads your memory manager. For 386MAX, you would add AMRS=*n* on the line with 386MAX.SYS, where *n* equals the number of sessions you run concurrently. This way, each session will have its own EMS alternate map set, multitasking will be more efficient, and application performance will be enhanced.

THE INITIALIZATION DILEMMA

At issue here is the amount of memory it takes to *initialize* programs like device drivers and TSRs. A program that occupies, say, 15K once loaded may require twice as much memory or more during initialization. With insufficient memory for initialization, such programs simply won't load. For example, the Logitech mouse driver takes up 28,285 bytes on our hard disk, but when we do a MEM/C it shows that the same driver occupies only 12,976 bytes of upper memory. To get it loaded high, though, there must be approximately 28,500 bytes of upper memory when the program initializes, or it won't load high.

Using our hand-tooled approach, we were able to load all the files high using both 386MAX and QEMM-386. NetRoom, however, still fell a little short of providing enough memory to accommodate all the files in upper memory. We had to do a bit more handiwork before we

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were able to get NetRoom tooled up to meet this challenge.

An examination of the upper memory area (using NetRoom's Discover utility) revealed that the EMS page frame was taking up space that might otherwise be devoted to drivers and TSRs. Since our intention was to run Windows only, we decided that we didn't need the EMS page frame and eliminated it by adding the appropriate switch to the command line. With the page frame out of the way, we were able to load all of our TSRs and drivers high under NetRoom as well. In accepting this configuration, however, we sacrificed the ability to take full advantage of software that uses EMS.

At this stage, the three memory mangers differed only slightly in the conventional memory they made available; all hovered around 615K. Not a bad day's work for our challengers: 205.7K of program code that had been occupying valuable lower memory real estate was all loaded high. True, NetRoom required us to remove the EMS page frame, but this was an optimization decision that made sense—for us.

CHALLENGE #2: THE LAPTOP WITH TSRs

Our second test-bed was a traveling system equipped for telecommunication via MCI Mail: a Data General Walkabout 320N (very similar to the TI TravelMate 3000) with 4MB of memory and a 60MB hard disk. We loaded the Walkabout down with the more than 228K of TSRs that make up the MCI Mail manager, Lotus Express. Then when we added the device drivers for SETVER and a mouse (17K total), the challenge to free up valuable conventional memory space became a formidable one.

To complicate matters, not only do Express's four component TSRs have to be loaded in a specific order, but each must find its predecessor loaded *below* it in memory, or it won't load at all. This means that if one TSR loads low, all must load low; if one loads high, all must follow suit. Since the baseline on the laptop was 371K of conventional memory, though, merely installing the memory managers on this system proved a challenge. We thought the challenge was typical of the kind that users would encounter with poorly behaved TSRs.

MEMORY MANAGEMENT METHODOLOGY

Memory managers typically run several (usually three, sometimes more) *passes* while optimizing your system.

During the first pass, the program places its own drivers in CONFIG.SYS and then reboots your system. During the second pass, the program attempts to load device drivers and TSRs high and then reboots your system to make sure they do load properly. In a final pass, the program reconstructs CONFIG.SYS and AUTOEXEC.BAT, now optimized for your system, and reboots one more time.

When we attempted to do a normal installation and default optimization, 386MAX locked up the system; NetRoom ran through an initial Customize pass, then aborted with the message "Not enough memory to run." Of the three memory managers, QEMM-386 alone was able to complete a simple install and optimize, which yielded 464K of conventional memory. The four Lotus Express files stayed low.

386MAX, as it turned out, was hooking an interrupt that the Walkabout had reserved for powering down the system to conserve battery life. Thus, every time we ran Maximize, it powered down the system. The folks from Qualitas scoped out

FACT FILE

QEMM-386, Version 6.02 List price: *$99.95.* **Requires:** *1MB RAM, DOS 3.0 or later. Quarterdeck Office Systems Inc., 1901 Main St., Santa Monica, CA 90405; 213-392-9851; fax 310-314-4219.*
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386MAX, Version 6.0 List price: *$99.95; BlueMAX (for Micro Channel machines), $124.95.* **Requires:** *256K extended memory, DOS 3.0 or later. Qualitas Inc., 7101 Wisconsin Ave., #1386, Bethesda, MD 20814; 800-676-0386, 301-907-6700; fax 301-718-6060.*
ON READER SERVICE CARD

NetRoom, Version 2.13 List price: *$99.* **Requires:** *64K extended memory on 286 machines, 640K on 386 machines, DOS 3.2 or later. Helix Software, 47-09 30th St., Long Island City, NY 11101; 800-451-0551, 718-392-3100; fax 718-392-4212.*
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OPTIMIZING DISK CACHES

A disk cache uses memory to buffer data written to or read from a disk. This can speed up the overall throughput of disk access. However, users should compare the speed of operations before and after a disk cache is installed. You'll need to decide whether the increase in speed is worth the cost in memory to use the cache. This is particularly important for those with limited memory resources or high memory requirements. The best test is to work with programs that you normally use. Remember, not all computing processes benefit from a disk cache, and the disk cache software itself occupies valuable conventional memory space unless you load it high.

MANAGING WINDOWS' DISK CACHING

Windows itself uses a lot of memory, so if your system has limited memory (3MB or less), and adding memory is not a realistic alternative, you may be able to free up some system memory by reducing the size of your disk cache. Whether you deliberately chose the size of the cache at setup or went with the software's default size (a fixed size with some packages, a percentage of system RAM with others), chances are you can make it smaller without totally negating its usefulness. While bigger is better (up to a point), caches as small as 256K can deliver noticeable performance boosts.

To preserve conventional memory, load the cache device driver into upper memory with DEVICEHIGH (DOS 5.0) or LOADHI.SYS (QEMM-386), and the cache itself in extended or expanded memory. The disk cache will then occupy zero conventional memory.

this problem right away and were able to patch their program on the spot while they were in our labs. Once patched, 386MAX ran fine on the Walkabout, but, like QEMM-386, succeeded only in recovering about 90K of conventional memory. No amount of tuning or tweaking, interactively or by hand, could coax more memory out of the system.

The NetRoom problem was also troubling, but ultimately not serious. Because the Lotus Express TSRs loaded low during one of the install passes, there was no room for the Customize program to load when the system rebooted. But NetRoom provides a program called STRETCH to deal with this type of situation. With STRETCH loaded (via the AUTOEXEC.BAT file), NetRoom's Customize picked up where it had left off, and we were able to finish a default install. Once again, though, only about 90K was recovered.

At this point, a Helix representative hand-tweaked the Walkabout for hours—and eventually succeeded in getting all of Lotus Express loaded high. Once again, we had to remove the EMS page frame to do it (we also had to load every other driver and TSR low), but it was exciting to use the MEM command and find 591K in conventional memory.

Hand-tweaking NetRoom best shows off its capabilities. The newly reworked Discover utility is a well-integrated set of tools that make the process fun. With it, we were able to load programs temporarily in the HMA, move and remove the EMS page frame, and test including and excluding various regions of upper memory (not automatically claimed by the memory manager). We did the editing within Discover, then rebooted, then returned to Discover to examine the results. In fact, at one point, we just added Discover to our AUTOEXEC.BAT.

Discover does it all. From drop-down menus you can view easy-to-read maps of your expanded, extended, or upper memory. You can also edit your CONFIG.SYS or AUTOEXEC.BAT file. Helix's optimize program, Customize, runs from inside Discover as well.

What's difficult to convey about Discover is that it is as easy to use as it is powerful. For example, every menu item is supported with context-sensitive help. This alone makes it possible to select options when running Customize that you might otherwise avoid, just because you weren't sure about the implications. When the "Select advanced RAM-MAN parameters?" question pops up, select Yes, then ask for help about each of the options in turn. The help is actually in *English!*

Once we knew that loading Express high was a possibility, we returned to QEMM-386 and its Stealth option. In fact, the Quarterdeck representative took it as a personal challenge to at least equal the results returned by NetRoom.

BYPASS MEMORY MANAGER AT BOOT

If you are trying to configure your system with QEMM-386 or 386MAX and it locks up, but you have no boot floppy, don't panic. Just hold down the Alt key during reboot, and the system will not load the memory manager's device driver.

Quarterdeck's Stealth technology uses a frame buffer just like the 64K EMS page frame, to squeeze the system ROM into less upper memory. Unused pages are then swapped in and out of the frame as needed. There are two documented Stealth methods for managing ROMs. Stealth M (*M* for *mapping*) takes advantage of the memory-mapping features of the 386/486 processor to map the ROM into extended memory. Stealth F (*F* for *frame*) uses part of the existing EMS page frame to do similar ROM swapping.

Both these methods make significantly more upper memory available for loading drivers and TSRs high. On our DG Walkabout, for example, without Stealth there was 123.8K of upper memory. With Stealth M enabled, we increased that to 207.6K of upper memory. With Stealth F enabled, we had 171.8K of upper memory. Your mileage may vary, but it is typical for Stealth M to outgain Stealth F.

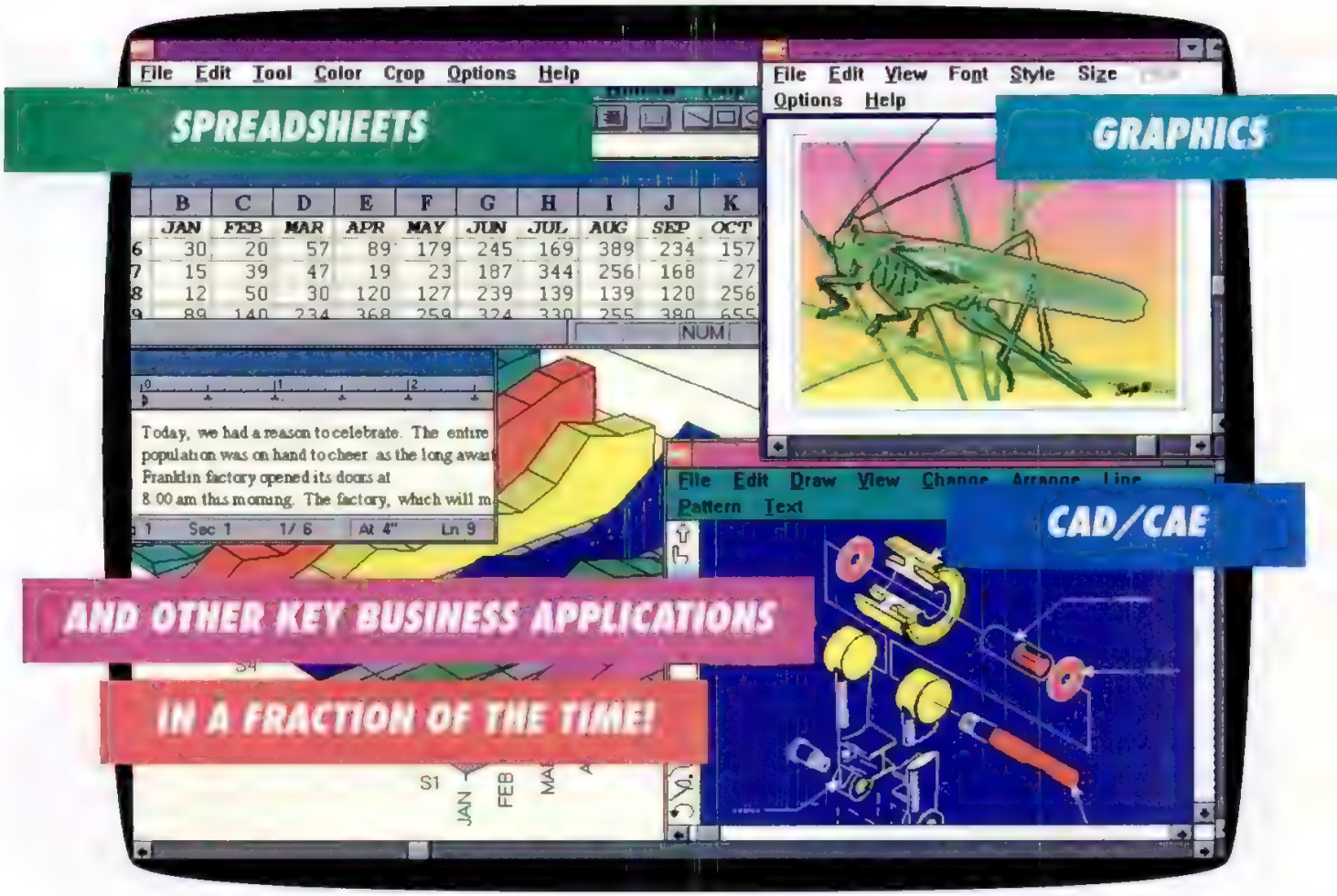
Unfortunately, our Walkabout would not operate reliably in Stealth M mode. Apparently, some of the video address information was hard-coded, so that calls to video routines were actually calls to absolute memory locations. Stealth F worked fine, but didn't reclaim enough upper memory to load Lotus Express high.

UNDOCUMENTED STEALTH

Quarterdeck would not accept defeat, however. As it turns out, there is another, undocumented, Stealth mode called Stealth P (*P* for *protected mode*). Quarterdeck does not advertise Stealth P, and the company does not support it. Further, it will not work if you run software that switches the computer into protected mode, thereby eliminating any system running Windows.

Since our intention for the laptop system was simply to be able to keep Lotus Express loaded, poll our MCI mail box every hour, and still have enough memory to use the computer, the lack of Windows was not a problem. We decided it was time to be adventuresome. Stealth P, when activated, provided a whopping 271.4K of upper memory—just enough to load Express.

Finish Faster!



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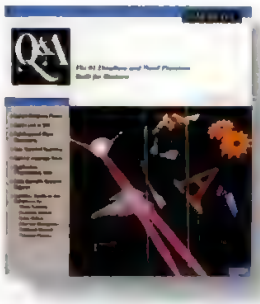

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For those brave enough to try Stealth P (we have been using it without problems ever since), you can enable it by editing your CONFIG.SYS. Just add ST:P on the line that loads QEMM386.SYS, and away you go. For our purposes, it signified a tie between QEMM-386 and NetRoom. Both were able to provide 591K of conventional memory.

WHEN THINGS DON'T WORK

When memory managers work properly, they are marvels. When they don't, nothing can be more frustrating. For example, your system hangs when you install it, or Windows won't load. Your favorite programs, ones that ran fine *before* you installed a memory manager, now lock up your computer.

Normally, installing MS-DOS 5.0's extended memory manager, HIMEM.SYS (or QEMM386.SYS, RM386.SYS, or 386-MAX.SYS), involves nothing more than adding a line to the CONFIG.SYS file, and everything works as advertised. However, since all of these memory management drivers work closely with the hardware, some people will probably experience problems even at this stage.

If you're lucky, any problems you have will be accompanied by an error message at reboot that says the driver (HIMEM.SYS) was "unable to control the A20 line." (A20 is the designation of the microprocessor address line that controls access to the high memory area, the first 64K of extended memory.) Although it's far from common knowledge, DOS affords a measure of control over how the line A20 *handler* works, by means of a switch on the CONFIG.SYS line that loads the memory manager. The format is /MACHINE:*n*, where *n* is a number designating a version of the A20 handler specific to a particular computer. If you have a Toshiba, for example, the command line should read HIMEM.SYS /MACHINE:7. This HIMEM.SYS feature is documented in the DOS 5.0 manual. Also, any README files distributed with DOS contain updates on machine-specific switches.

When memory managers work properly, they are marvels. When they don't, nothing can be more frustrating—they can lock up your computer.

If you're not so lucky, you may have to embark on some of your own detective work. Here are some clues to help you. When you type WIN, does Windows begin to load, then drop you back to the DOS prompt? It could be a problem with your A20 handler. When Windows tries to switch your computer into protected mode, it bombs.

If there is no information about the correct configuration switch for your computer in any of the documentation, and you do get the A20 error message, you'll have no choice but to use trial and error. Have a boot floppy handy in case

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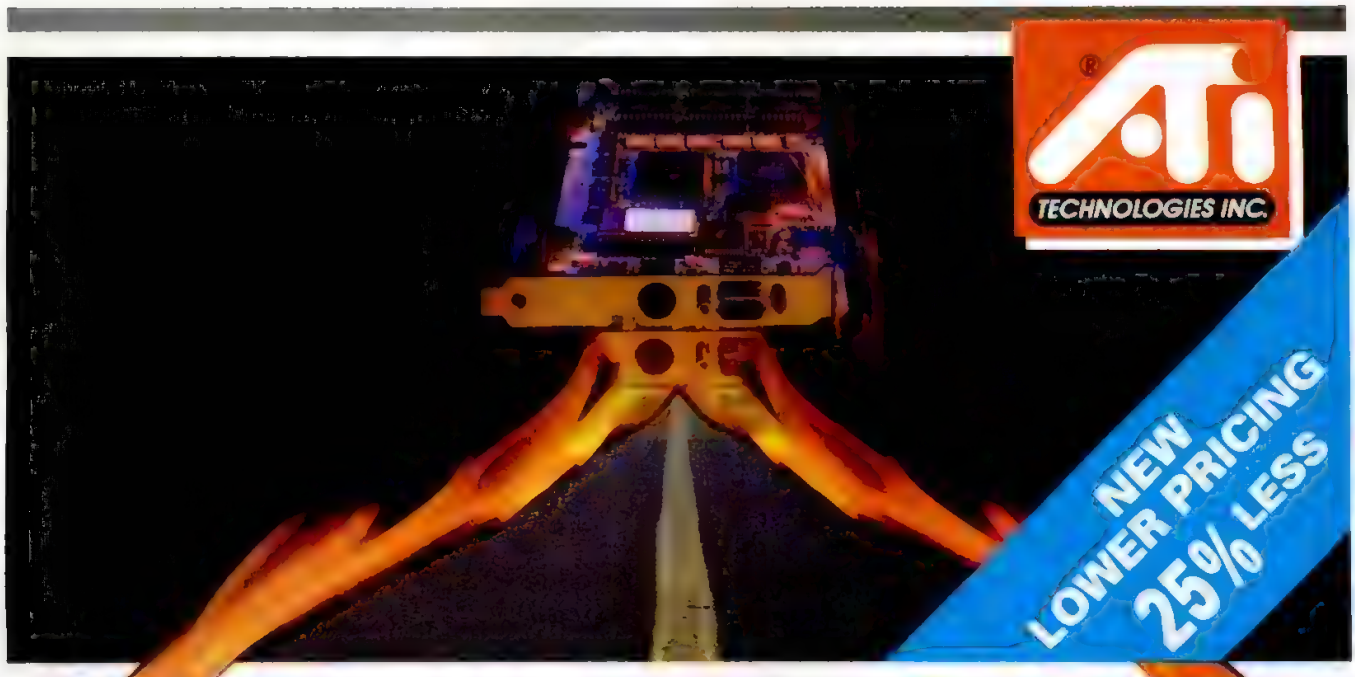

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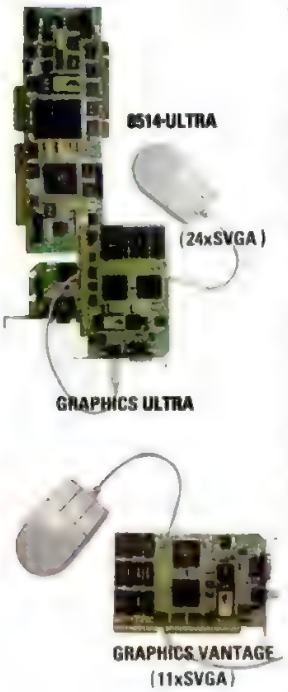

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your computer locks up. Try the /MACHINE:*n* options one at a time until you find one that works.

DOS 5.0's EMM386 can also cause problems. A fairly common one is that the PC will lock up when EMM386 is loaded. The problem occurs because, unlike the commercial memory managers we review, EMM386 doesn't search the HMA for memory conflicts. The solution: Use EMM386's X= switch to exclude the entire upper memory area, then repeatedly cut the excluded memory address range in half until you find the offending area.

HIGH-LOAD BLUES

One of the most common nagging problems people encounter is a program that seems like it should load high but doesn't. As noted earlier, one reason may be that the program requires more memory to initialize than it does to run. In this case, try changing your load order (being careful *not* to change the load order of programs that are dependent on each other; for instance, you can't load NETX.COM before loading IPX.COM).

On the other hand, sometimes the upper memory regions are just too small. The total upper memory is sufficient, but the region in the largest block is not. Most programs need to load into *contiguous* memory. To alleviate this problem, try removing your page frame or relocating your ROM BIOS. Each of the memory managers will allow you to do this (and document the procedures), though you'll probably have to do it manually, by editing CONFIG.SYS.

MANAGING TOKEN RINGS AND PS/2s

A Token-Ring card on an IBM PS/2 will pose a problem for an expanded memory manager. By default, the Token-Ring card puts its ROM and shared RAM buffer in address locations between 640K and 1,024K. The card does this in such a way that it fragments the area, leaving no contiguous 64K region available for the EMS page frame. If the memory manager doesn't find a 64K chunk of available space between 640K and 1,024K, it puts the page frame in conventional memory, and you discover that your conventional memory has been reduced by 64K. The solution is to run the PS/2 Reference Disk, and move the ROM and/or the RAM buffer to make room for the page frame.

CONFLICTS OF INTEREST

Even if your memory manager is installed and working fine, changing something in your system configuration can cause problems. We encountered such a situation in our *PC Magazine* offices when we upgraded to Windows 3.1. The error message we saw time and time again was, "Windows cannot set up an upper memory block at B000." All we had done was install Windows 3.1, and change our system setup to take advantage of the 800-by-600 video drivers that are new to Version 3.1.

Of course, most 800-by-600 video drivers expect to find memory available in the B000 upper memory region and need that memory to work. When we originally installed our memory manager, it noticed that the B000 region was empty, and used

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it to load programs high. To eliminate the conflict, we excluded that region of memory (for example, with "EXCLUDE:B000-BF00" on the line that loads HIMEM.SYS), so that our memory manager would not use this area for loading programs high. Memory conflicts like this are common if you change system hardware, such as video adapters or network cards.

Then there are those drivers and programs that just can't be loaded high. One of our work machines has an old Proteon Token-Ring card in it. The version of IPX.COM that it uses loads high without a problem—until we try to connect to the network. It just won't connect. Therefore, we keep the IPX loaded low on that machine in order to avoid conflicts on the network.

We encountered a similar problem with the video addressing in the DG Walkabout 320N. Apparently, calls were being made to absolute memory locations in hardware. Today, this is considered poor behavior, but back when the Proteon network card was designed, it was considered expedient and basically fine. In the case of the Walkabout, the designers just assumed that the video system would not change; actually, quite a reasonable assumption. Who, after all, would change the video system in a laptop computer? They just lacked vision, and didn't consider the possibility of software intervention and a memory manager trying to remap video memory.

DIAGNOSING PROBLEMS

The first step in fixing a problem is to seek out the cause. It sounds simple, but, as in internal medicine, you often can't see the cause, just the symptoms. Solutions usually involve manually editing your CONFIG.SYS or AUTOEXEC.BAT. Often, the only tools you'll need are a text editor and a lot of patience.

There are two approaches to finding and fixing memory problems. One is to begin with an absolute minimal setup, then move forward one step at a time, adding devices and TSRs until the problem recurs. For instance, try returning to a bare-bones CONFIG.SYS and AUTOEXEC.BAT, then add your memory management software (HIMEM, QEMM-386, and so on), then load one device or program high at a time. The second approach is just the reverse. *Comment out* (disable or even delete) your LOAD HIGH lines one at a time, moving backward until the problem disappears.

Which method is better? If you have some idea what might be causing the problem, move backward, starting with the most likely offender. If you have no idea, start from the beginning. In either case, be careful to take it one step at a time. Isolating the problem is the key to connecting it with a symptom. It's not a bad idea to keep progress notes on paper, especially if your system is complex.

If after trying these two approaches you still can't isolate your problem, there are some general suggestions we can make. First, there is no substitute for understanding the technology, so read the software manual. Quarterdeck, Qualitas, and Helix have all made great strides in improving the accessibility of their documentation. Sure, it's still dense and difficult, but there's a lot of valuable information inside, and effort expended here is likely to be rewarded.

If you have exhausted that avenue and are still willing to seek out answers to your

TACKLING BUS MASTERING

Certain hard disk controllers (nearly half of all SCSI controllers) perform some trickery called *bus mastering*. Basically, this means they are able to access memory directly without using standard DMA (direct memory access) channels on the PC. While this procedure makes for fast disk performance, it can defeat an expanded memory manager's address scheme. The problem occurs when the cache software or buffers are established in an area of virtualized memory addresses, such as in upper memory. Unless special provisions are made, serious problems—including system crashes and the destruction of all data on the hard disk—can occur when you load the DOS buffers or disk cache software into upper memory.

A special device driver, VDS (Virtual DMA Services), has been developed to address this problem and can usually be obtained from hard disk vendors. This driver allows memory managers to communicate with—and thus work safely with—a bus-mastering device. If you have Microsoft's SMARTDrive 4.0 (the version shipped with Windows 3.1), you can enable one of its optional features, double buffering, to achieve the same results.

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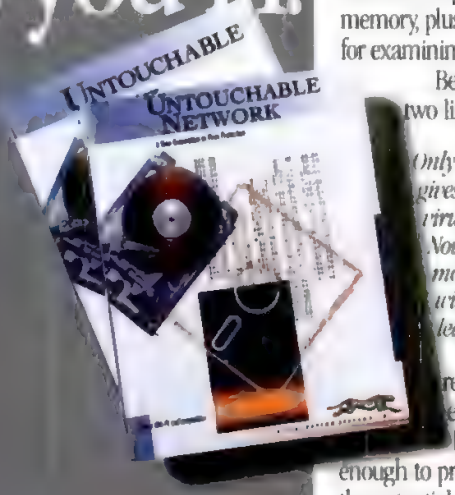

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questions, try a book about memory management. There are a number of excellent guides to memory management, and one may suit you perfectly (see our Suggested Reading list). Though many focus on DOS 5.0, they also spend a lot of time on principles and techniques that apply to all memory management.

Don't overlook the README files that come with your memory manager. The technology changes fast, and printed documentation often lags far behind the live product. Helix's documentation for Stretch, a utility we needed to get up and running on the Walkabout, could be found *only* in the README file. It's usually impossible to read these files at critical junctures of an install process, so use a little foresight and print and read them ahead of time.

As we worked with the vendors to optimize their products' performance, it became clear that these guys are experts. Before you give up on a problem, give them a chance to help. Call technical support. Visit their support sections on CompuServe, or call their BBS. Besides their interactive help, they will often provide white papers on different aspects of the technology or technical notes on specific problems. Many of these documents are also available as files that can be downloaded from their on-line support areas.

Helix's support bulletin board can be reached at 718-392-4054. Quarterdeck can be reached on CompuServe (GO CIS:PCVENB, Section 1), as can Qualitas (GO CIS:PCVENA, Section 8).

LOADING THE MOUSE IN HMA

If you're loading DOS 5.0 into the HMA, and you've installed a disk cache (like SMARTDrive or Super PC-Kwik) so that you can reduce the number of DOS buffers to the minimum (three), you will still have a substantial chunk of unused memory in the HMA. (If you specify more than three DOS buffers, they will reduce that available space at the rate of approximately 512 bytes per buffer.) An undocumented switch, /U, will load the Microsoft Mouse driver (Version 8.1 and above) into this HMA memory space. More accurately, you can load all but about 4K of the driver into the HMA. The remaining 4K will load low by default but can be loaded into upper memory using the appropriate CONFIG .SYS or AUTOEXEC.BAT statement.

DOS 5.0: THE APPETIZER

Start with DOS 5.0. After all, for the price of a third-party memory manager, you get HIMEM.SYS, EMM386.EXE, *and* an operating system. DOS 5.0 offers many of the same features found in the memory management programs we tested. Even though you have to do it manually, HIMEM.SYS and EMM386.EXE allow you to manage extended and expanded memory and load device drivers, TSRs, and even the DOS kernel high. And you can load some of the system, your buffers, and (though this is not documented) your mouse driver (Version 8 and above) in the HMA. To top it all off, if you find that you do require more advanced memory management than DOS provides, the three programs we tested all work better with DOS 5.0 than they do with earlier versions of DOS.

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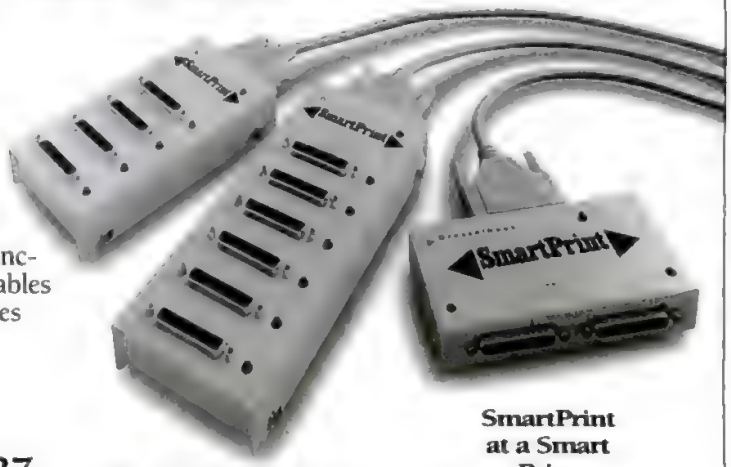

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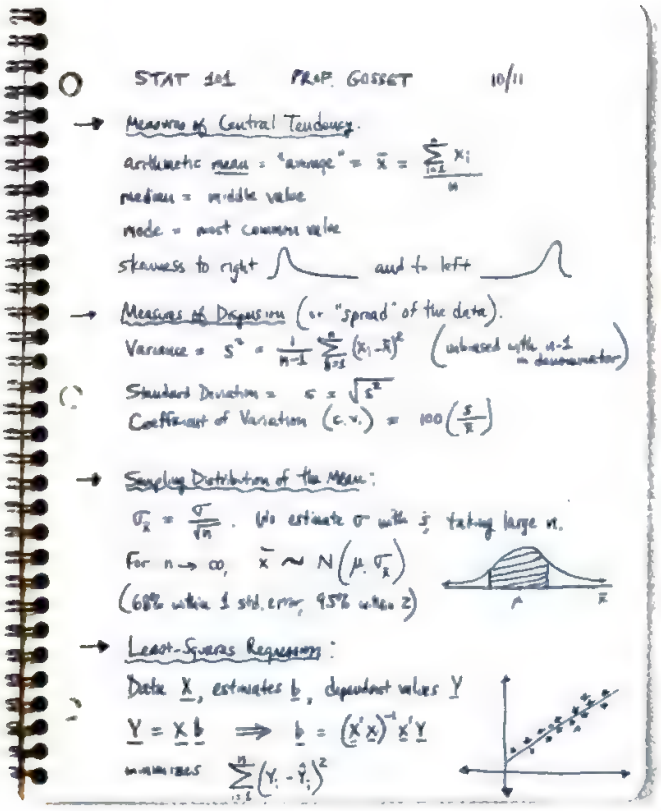

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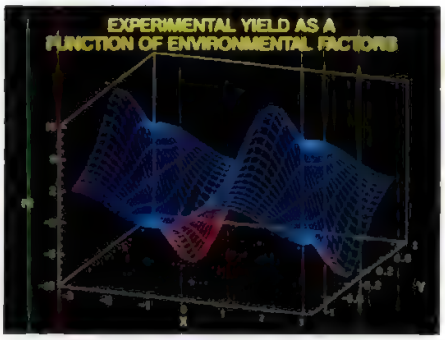

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PC MAGAZINE EDITORS' CHOICE

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Suggested Reading

Memory management is a complex subject, and although we've taken a long, hard look at it here, we haven't told you *everything* there is to know. Fortunately, a number of good books are readily available—including some that may be right under your nose.

Remember when you bought your PC? If it came bundled with DOS 5.0, then it probably also included the hardware vendor's guide to the operating system. If you bought the DOS 5.0 upgrade kit, look at the user's manual. These volumes contain many useful tidbits on the ins and outs of memory and answers to many of your memory-configuration questions. Some of them have diskettes containing utilities for easier management.

Memory Management and Multitasking Beyond 640K; Bailes, Lenny and Mueller, John. TAB/McGraw-Hill; 800-233-1128; $39.95 (hardcover), $29.95 (paperback).
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DOS 5: An Advanced Guide to Putting Microsoft's Breakthrough Software to Work for You; Glossbrenner, Alfred. Random House Electronic Publishing; 800-726-0600; $50.00.
480 ON READER SERVICE CARD

DOS: The New Complete Reference; Jamsa, Kris. Osborne/McGraw-Hill; 510-549-6600; $29.95.
481 ON READER SERVICE CARD

PC Magazine's Guide to DOS 5 Memory Management; Prosise, Jeff. Ziff-Davis Press; 510-601-2000; $34.95.
482 ON READER SERVICE CARD

PC Magazine's DOS 5: Techniques and Utilities; Prosise, Jeff. Ziff-Davis Press; 510-601-2000; $39.95.
483 ON READER SERVICE CARD

DOS Power Tools: Techniques, Tricks and Utilities; Somerson, Paul. Bantam Computer Books; 212-765-6500; $49.95.
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We optimized our test computer using DOS 5.0, and through an iterative procedure, were able to gain 104K of lower memory—from its baseline 481K up to 585K; quite an impressive achievement. Although all three memory managers were ultimately able to reclaim more, you may not need more, in which case DOS 5.0 is all the memory manager you will need.

Since DOS 5.0 provides no interactive program to aid you in memory optimization, you must do it manually. It's not that hard. Just use a step-by-step common sense approach, following these general guidelines:

1. Load HIMEM.SYS and EMM386.EXE as the first lines in CONFIG.SYS.
2. Add DOS=HIGH,UMB to CONFIG.SYS.
3. Add DEVICEHIGH (in CONFIG.SYS) and LOADHIGH (in AUTOEXEC.BAT) statements.
4. Experiment with load order.
5. Locate and experiment with unused UMBs. To do this, you'll need a diagnostic tool like the MSD program that ships with Windows 3.1, or a commercial program, like DiagSoft's QAPlus/WIN.

You should be sure to have a bootable DOS 5.0 floppy disk within reach, in case you encounter problems during the boot process.

No matter which memory manager you use, you'll probably end up confronting the question of whether to play it interactively and safe, or forge ahead manually and gamble. The more you push the envelope, the more likely you are to encounter problems. You can't really break anything, though, so the gamble isn't all that risky, especially if you always keep copies of your *working* CONFIG.SYS and AUTOEXEC.BAT. That way, when your next step turns out to be over a cliff, returning is as easy as copying back an old version of your setup.

BEYOND DOS 5.0: WHICH ONE TO BUY?

These three programs all deserved to be Editors' Choice winners when they were chosen as such, and they all still do. They give you tools and tricks that DOS 5.0 doesn't. They all implement the technology of memory management superbly. In short, any of the three will do the job for you. That said, there *are* differences between the programs—and their overriding philosophies—and reasons a buyer might choose one over another.

Quarterdeck's philosophy is to maximize memory at all costs. While some of its techniques, Stealth for example, are able to deliver more RAM, they are also more troubleprone and can be exacting to work with. On the other hand, QEMM-386 was consistently the easiest to install, and also the most compatible across different systems.

Qualitas's design philosophy is more conservative. 386MAX can't always deliver as much memory as QEMM-386, but it is generally more reliable. (Qualitas gets considerably fewer support calls.) Further, 386MAX is the only one of the three programs that supports DPMI—and can act as a DPMI server. Though there are few programs today that require this type of support (Microsoft's C/C++ 7.0 development environment is one), it may be a factor for you.

WHEN TO LOAD NETWORK ADAPTER CARDS

Many network adapter cards have a shared-RAM data buffer. The RAM buffer is memory on the network card that occupies address space somewhere between 640K and 1,024K. Memory managers often have trouble detecting this RAM buffer because it's usually not initialized when the memory manager loads. You can solve this problem by loading the memory manager in CONFIG.SYS first. Now, the memory manager will load before the network software—and before the buffer is initialized. However, if you install a third-party memory manager such as QEMM-386 or 386MAX, you should perform the install after logging on to the network. This may enable the setup program to detect the hidden adapter RAM.

If you install a memory manager and find that you can no longer access the network, check the network card manual to find out what address range the card occupies. Use an Exclude parameter on the memory manager's line in CONFIG.SYS to prevent it from using the area the RAM buffer needs. Some networks even have a command that will display what address range the network card is using. Novell's IPX will do so if you type the following: IPX I.

Peter Norton On Desktops.

For many years, I have worked to help people gain mastery over their PCs by developing a number of powerful DOS enhancements and utilities. But these products were targeted to the more technically advanced user.

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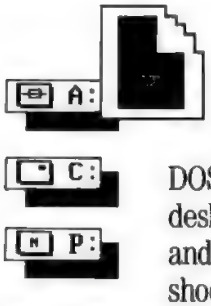

Drag-and-drop ease of use comes to DOS. To move files from your hard disk to a floppy drive just point and click.

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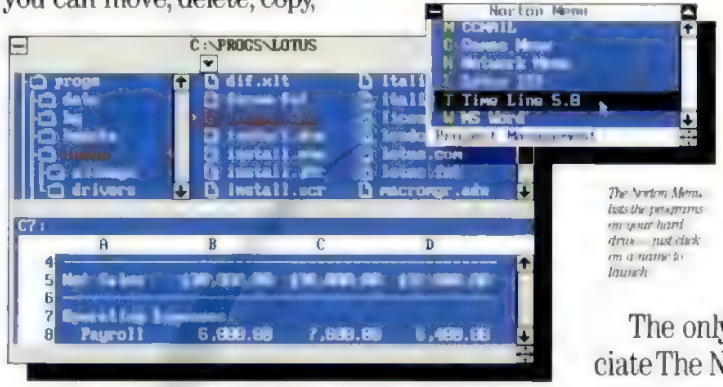

The Norton Menu lists the programs on your hard drive — just click on a name to launch.

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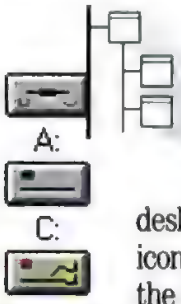

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Experience full drag-and-drop support across the entire desktop. Drag a file or drive icon to any desktop icon or onto the desktop itself—for instant access. Copy, move, delete, or print files by clicking and dragging them to buttons and icons.

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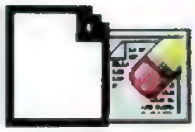

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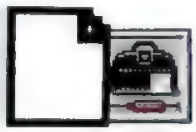

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System Requirements

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- Windows 3.0 or higher
- IBM AT, PS/2 or 100% compatibles
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- 9 MB free disk space (for full installation)
- EGA, VGA, XGA, or SVGA video card

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Qualitas also offers an IBM PS/2–specific version of its product, called BlueMAX, which provides users with a unique way to handle the IBM ROM. With BlueMAX installed, you can almost forgive the IBM design engineers who decided they could fill all the upper memory area any old way they pleased. (When will they learn that all system resources are valuable?) Qualitas also provides the best manuals of the three reviewed products, especially for the less-experienced user. If you are willing to spend some time with its documents, you'll come away understanding the technology.

EASY DOES IT

Ease-of-customization honors go to NetRoom. The tools that come with NetRoom—primarily its Discover utility—not only outpaced the other contenders (Quarterdeck's Manifest, Qualitas's ASQ/MFT combo), but made it fun to work with. Discover not only provides you with all the information you need about everything from memory allocation to relative memory performance, it does so in an easy-to-use shell that includes a simple text editor. If you're going to roll up your sleeves and work with all of these technical details, Discover is the way to do it.

NetRoom also includes Netswap, a nifty utility that lets you create a virtual machine as large as 576K. It's useful for those who have far more drivers and programs to load high than space in which to load them. Netswap uses a page-swapping technique that is similar to EMS page swapping, which produces a slight performance hit. For those who have everything—like a network, CD-ROM, and a sound board—Netswap could prove to be invaluable.

If pricing is an issue—that is, if you are considering a site license for one of these products—you should note that Quarterdeck holds to a one-user, one-license fee structure. Both Helix and Qualitas are willing to discuss strategies that make sense for large shops.

The bottom line? If you want the program to do the work, choose QEMM-386. If you need a DPMI server, or you have a PS/2, pick 386MAX or its cousin, BlueMAX. If you want to take charge, NetRoom has the tools you need to take control and stay in control. □

THE ULTIMATE TRICKSTERS

How DOS Memory Managers Work

by Jeff Prosise

Here's a behind-the-scenes look at how memory managers accomplish their memorable sleight of hand. DOS recognizes four different types of memory: conventional, upper, extended, and expanded. The first three differ only in the locations they inhabit on the DOS memory map: *Conventional memory* occupies the first 640K (that is, from 0 to 640K). *Upper memory* resides between 640K and 1,024K (1MB). *Extended memory* starts at 1MB and continues to the top of the physical memory present in the system. On a 286 or 386SX, this can be as much as 16MB. On a 386DX or 486, the limit on the microprocessor's physical address space is 4 gigabytes.

Memory managers are bandages, not cures, for memory woes that afflict DOS users.

Expanded memory, however, lies outside the processor's normal address space and must be accessed using a special piece of software called an *expanded memory manager* or *EMM,* which is one function of a commercial memory management product. The EMM divides expanded memory into a series of 16K units called *pages.* It also sets aside 64K of unused address space in the upper memory area to serve as an EMS *page frame.* (*EMS* stands for Expanded Memory Specification, an industry standard promulgated by Lotus, Intel, and Microsoft, and thus often referred to as LIM EMS or LIM.) An EMS-aware application program can place calls to the EMM, which then *maps* EMS pages to the page frame as needed. An EMS page that is mapped to the page frame can be read from and written to as if it were part of the RAM installed on the system board. Therefore, by swapping pages in and out of the frame, an EMS-aware program can access as much expanded memory as the EMM is designed to handle (8MB in EMS 3.2; 32MB in EMS 4.0).

PRIME REAL ESTATE

The designers of the first IBM PC decided to reserve the upper memory area (again, the memory space between 640K and 1MB) for video buffers, system ROM, and the ROM and RAM installed on adapters. It turns out, though, that some of this space is unused on most PCs. A memory manager lets you recover wasted address space in this region by converting unused areas into pockets of usable RAM called *upper memory blocks,* or *UMBs.* Then, using special software utilities such as LOADHIGH and DEVICEHIGH (the DOS 5.0 commands to load TSRs and device drivers, respectively, in upper memory) or LOADHI .COM and LOADHI.SYS (the QEMM-386 equivalents), you can load code and data into UMBs. The result? You can get some or all of your TSRs and device drivers out of conventional memory, leaving more of it available for running application programs.

Memory managers come in two varieties. More common is the virtual-mode memory manager, which runs DOS in the Virtual 86 mode of the 386 chip and uses a feature of the 386 called *paging* to create UMBs. (Paging is a method by which the CPU can fool a program into thinking it is accessing one location in memory, when

in fact the program is accessing another.) At startup, the memory manager scans the upper memory area for unused address space that it can convert to UMB RAM. Then it programs the 386 so that accesses to these holes in memory are rerouted to extended memory. To DOS, it appears that the holes have been magically filled with RAM. Paging is implemented at the chip level, so applications are unaware that they are using extended memory when they access a UMB.

Real-mode memory managers, which are designed to run on 8086/8088- and 286-based PCs, take a different approach to creating UMBs. If there is EMS 4.0 expanded memory on-board, a real-mode memory manager will create UMBs by mapping pages of EMS memory into unused areas of upper memory. If the host PC contains no expanded memory but was built with one of several popular chip sets that supports remappable shadow RAM, the memory manager will exploit this feature to map blocks of extended memory down into upper memory.

Virtual-mode memory managers, however, offer services that real-mode memory managers cannot. For example, most virtual-mode memory managers will let you convert extended memory to EMS 4.0 expanded memory. And most will transfer code from slow 8-bit ROM to fast 32-bit RAM, boosting overall system performance. However, this gain is often offset by the fact that program execution in Virtual 86 mode is slower than in real mode, especially for computation-intensive programs that use certain floating-point-arithmetic emulation techniques when no math coprocessor is present. DOS remains in real mode when a real-mode memory manager is active, so there is no commensurate drop in performance.

TRICKS OF THE TRADE

Virtual-mode memory managers employ all sorts of tricks to free up space for UMBs. QEMM-386 6.0 uses a technique dubbed Stealth, which allows ROMs and UMBs to share the same space. 386MAX 6.0 uses *BIOS compression,* in which it identifies regions of ROM that do not play a role in the operation of the PC and then converts them to UMB RAM. Both methods have their risks, but they work for the majority of users.

A Generic CONFIG.SYS For Maximizing Your Memory

The settings in your CONFIG.SYS file have a dramatic impact on how much—or how little—of the lower 640K you have left for your applications to run in. The CONFIG .SYS file shown here demonstrates one way to maximize the executable program size using the commands and drivers supplied with DOS 5.0. CONFIG.SYS files set up for memory managers other than EMM386.EXE will vary.

```
❶ DOS=HIGH,UMB
❷ DEVICE=C:\DOS\HIMEM.SYS
❸ DEVICE=C:\DOS\EMM386.EXE RAM 2048
❹ DEVICEHIGH=C:\DOS\SMARTDRV.SYS 1024
❺ DEVICEHIGH=C:\DOS\RAMDRIVE.SYS 1024 /E
❻ FILES=40
❻ BUFFERS=10
❼ SHELL=C:\DOS\COMMAND.COM C:\DOS /E:224 /P
❽ STACKS=0,0
❾ FCBS=1
```

❶ Minimizes DOS's size in conventional memory by transferring most of DOS—the kernel, the disk buffers, and about half of COMMAND.COM—to the HMA (high memory area). The UMB (upper memory block) portion of this statement turns the UMBs created by EMM386.EXE over to DOS.

❷ Loads the HIMEM.SYS driver, which provides a mechanism for DOS and its application programs to use upper and XMS memory (extended memory controlled by an XMS driver such as HIMEM.SYS) cooperatively. HIMEM.SYS must be loaded if DOS is to be loaded high and if EMM386.EXE is to be loaded.

❸ Loads DOS 5.0's EMM386.EXE driver, which converts unused space in the upper memory area to UMB RAM or converts XMS memory to EMS 4.0 expanded memory, or both. Memory-resident programs and device drivers may be loaded into UMBs with the LOADHIGH and DEVICEHIGH commands.

❹ Instructs EMM386.EXE to create UMBs to hold TSRs and device drivers, and to convert 2MB (2,048K) of XMS memory to EMS 4.0 expanded memory. If RAM 2048 is replaced with NOEMS, EMM386.EXE will provide UMB services but will not provide EMS services.

❺ Loads SMARTDrive and RAMDrive—two of the device drivers supplied with DOS 5.0—into upper memory, reducing to zero the amount of conventional memory that they require.

❻ Establishes the limit on the number of files that can be open in the system concurrently (FILES=) and the number of disk buffers that DOS sets up (BUFFERS=). Each entry in the system file table consumes 88 bytes of conventional memory, so keep the FILES setting as low as possible. If DOS is loaded in the HMA, buffers also go in the HMA, provided the BUFFERS setting is 48 or less.

❼ Decreases the size of COMMAND.COM's master environment to 224 bytes. The default in DOS 5.0 is 256 bytes. The lower this setting, the more memory you save. You'll know you've gone too far if you receive an "Out of environment space" message when you run a batch file or issue SET commands. Insufficient environment space may also cause UAEs (Unrecoverable Application Errors) under Microsoft Windows 3.0.

❽ Eliminates the space that DOS sets aside internally to serve as local stack space when a hardware interrupt occurs. The default on 286 and later PCs is STACKS=9,128. Many PCs do not need this protection. If you add this statement to CONFIG.SYS and your PC subsequently locks up after displaying an "Internal stack overflow" message, restore STACKS to its original setting.

❾ Minimizes the space DOS sets aside to cache information contained in file control blocks (FCBs). If an application complains that it can't open a file, remove this statement. Otherwise, you save 176 bytes of RAM compared with the default setting of FCBS=4.

For another, more detailed look at a reader's CONFIG.SYS, see Jeff Prosise's Tutor column, "Optimizing Your Configuration," in this issue

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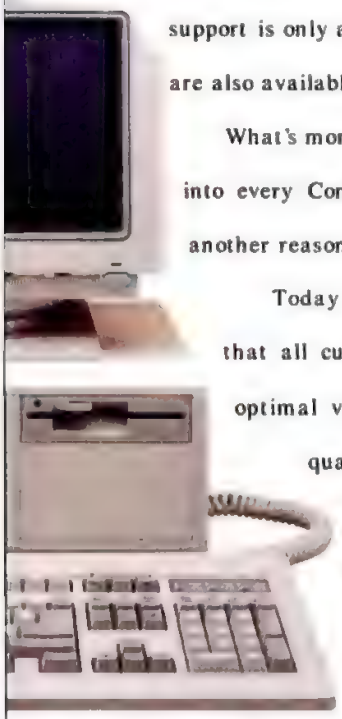

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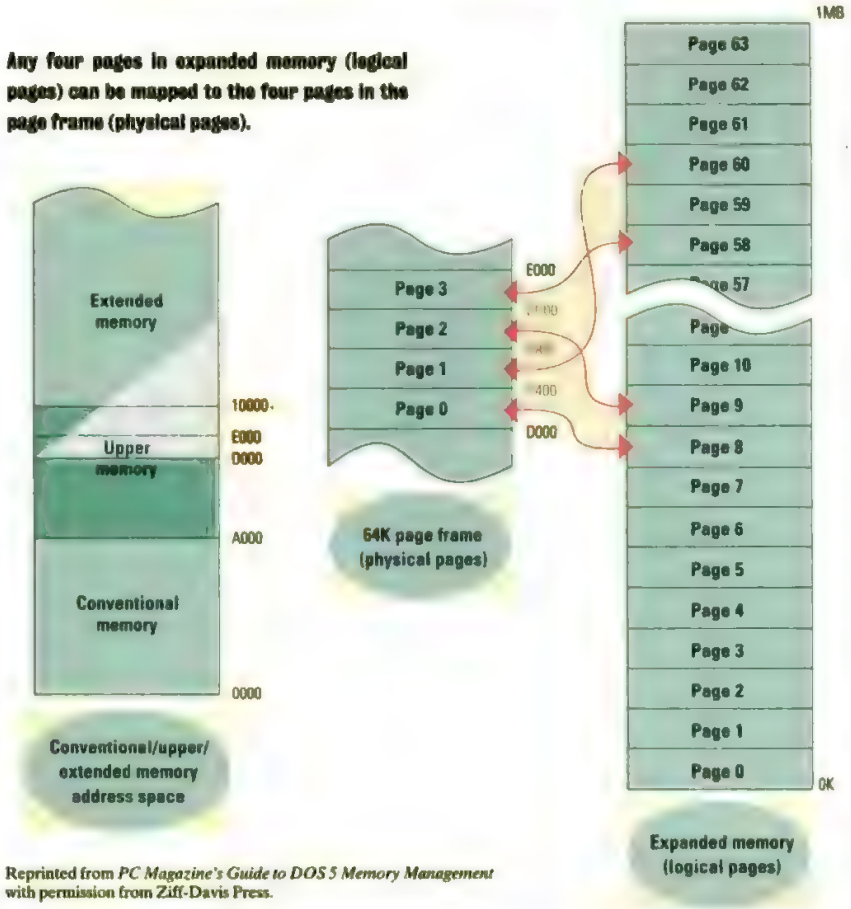
DOS 5.0's EMM386.EXE driver is more limited in that it will use only empty space in the middle 128K of the 384K upper memory region. Therefore, a default EMM386.EXE installation will not provide as much UMB RAM as a default installation of QEMM-386 or 386MAX.

One of DOS 5.0's best memory management tricks is totally unrelated to EMM386.EXE or any other memory manager. If you load HIMEM.SYS and add the statement DOS=HIGH to CONFIG.SYS, most of DOS will be loaded into the region of extended memory between 1,024K and 1,088K called the *high memory area*, or *HMA*. The HMA is the only part of extended memory that can be accessed while the processor is running in real mode—thanks to some addressing quirks discovered by programmers at Quarterdeck in the mid-eighties. Transferring DOS to the HMA gives back as much as 60K of conventional memory to executable programs.

Expanded Memory and the EMS Page Frame



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MEMORY MANAGEMENT PERILS

Using a memory manager—especially a virtual-mode memory manager such as 386MAX or EMM386.EXE—is not without its risks. If a memory manager inadvertently or unwittingly maps a UMB into a region of upper memory that contains ROM or RAM (and they often do, simply because it is impossible for software to identify all system-board ROMs and adapter RAMs with 100 percent accuracy), your PC will probably lock up. You can avoid such hangups by excluding problematic areas of memory from the memory manager's purview, usually by adding a switch to the statement in the command line that loads the memory manager at startup. It's easier said than done. Unless you know exactly what regions of upper memory are used by your PC and its installed adapters, you have to resort to time-consuming trial-and-error procedures.

Further, memory managers sometimes create compatibility problems. Programs that use 386 DOS extender technology to break the 1MB cap on real-mode memory are incompatible with virtual-mode memory managers unless they support VCPI (the Virtual Control Program Interface). VCPI, developed jointly by Phar Lap Software and Quarterdeck, defines a standard interface between DOS extenders and virtual-mode memory managers that allows both to coexist on the same system. The good news is that most popular memory managers, including QEMM-386, 386MAX, and EMM386.EXE, support VCPI. The bad news is that these memory managers generally must be acting as EMS providers if they're to act as VCPI servers, too. In simpler terms, if you install EMM386.EXE with the RAM switch, you can run AutoCAD, Release 11. If you install EMM386.EXE with a NOEMS switch (disabling EMS emulation), AutoCAD will not run. A related specification, DPMI (DOS protected-mode interface), may eventually provide some relief, but to date, 386MAX is the only major DOS-based virtual-mode memory manager that supports DPMI.

A more fundamental problem is that memory managers are bandages, not cures, for the memory woes that afflict DOS users. DOS is a real-mode operating system, and real mode limits the CPU to addressing at most 1MB of RAM.

Memory managers are good at filling in the holes by borrowing RAM from extended memory and at molding memory to better suit your needs (for example, converting extended memory to expanded memory for programs that will use expanded memory but not extended). But there's little they can do to lift the 1MB cap. The ultimate answer (if you ignore the possibility of building DPMI support into DOS and letting applications developers use DOS extenders to tap extended memory, something that is a strong possibility in future versions of DOS, is to move to an operating system such as OS/2 or an operating environment such as Windows that runs in protected mode, enabling programs to access directly the vast resources of extended memory on 286, 386, and 486 PCs. The downside, of course, is that application programs must be rewritten to take advantage of these environments. Unless we're willing to give up our favorite DOS applications as we know them, we're likely to be wrestling with the problem of limited memory for some time to come. □

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PacificTalk (AppleTalk interface module)	$199

*Sheet feeder I is required for use

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FROM PRINT TO PC

OCR Gets You from There to Here

Cheap printing and the fax revolution have left us trapped in our offices, shoveling through paper drifts. Clear a path to your door with one of these nine optical character recognition packages.

Still find yourself—or an assistant—retyping articles, memos, worksheets, and other printed information so it can be edited or more easily retrieved? Then it's high time to begin asking yourself why you're still doing it the old-fashioned way. In stark contrast to most past optical character recognition (OCR) offerings, the latest OCR packages not only afford a release from the tedium of typing, they also get the job done far quicker than the average touch-typist and with results that can be every bit as accurate.

OCR software lacks a typist's eyes, so it needs a scanner to create a bitmapped image of the page, which the software

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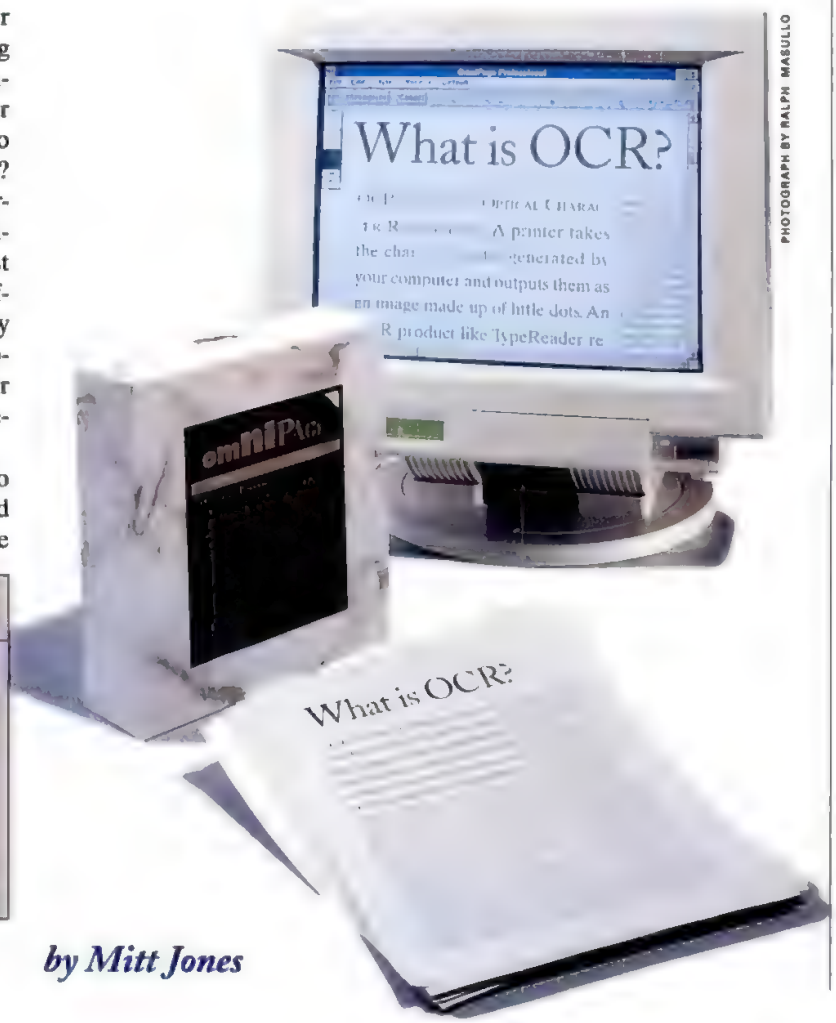

PHOTOGRAPH BY RALPH MASULLO

by Mitt Jones

Suitability to Task: OCR Software

Each of these packages is strong in at least one area, although OmniPage Professional, TypeReader, and WordScan Plus display the greatest flexibility.

If you plan to use OCR software on an **occasional** basis, you will probably need a package that can handle a little bit of everything. The most important characteristics of general-use OCR software, however, include an easy-to-use interface and fairly high accuracy on both straight unformatted text, in both portrait and landscape orientations, and simple two- or three-column layouts (speed is less important here). The ability to handle fax and dot matrix output acceptably is also desirable.

As you increase the **frequency** of your OCR jobs, a package's throughput (the combination of speed and accuracy) becomes more important, as well as its flexibility at handling deferred jobs, breadth and quality of output formats, and intelligence when you specify and reuse settings.

While an OCR package's ability to handle **complex page layouts** is one of the least commonly needed features, it is crucial if you need to input pieces from magazines, newspapers, and newsletters. Examples of complex layouts include embedded graphics with captions, sidebars, and tables (especially those with mixed numbers and letters).

The most common pieces of paper lying around any office are **poor-quality documents**: n^{th}-generation photocopies, memos used as breakfast placemats, draft dot matrix hard copies, faxes, and toner-deficient laser printouts.

A **foreign language** capability not only means the ability to recognize entire documents written in a language other than English, but also the ability to recognize foreign words embedded within English documents. Support for Latin-based alphabets is the major component of this task; without training is best, but with training is acceptable. Support for non-Latin alphabets, such as Cyrillic or Kanji, is a plus.

SUITABILITY TO TASK

Product Name	POOR	FAIR	GOOD	EXCELLENT
Occasional OCR	●	○	○	○
Frequent OCR	●	●	○	○
Complex page layouts	●	●	●	○
Poor-quality documents	●	●	●	●
Foreign languages	N/A			

N/A—Not Applicable: The product does not perform this task.

then analyzes and matches to known character values. The results are then saved into an ASCII file or in a specific application's format. Each of the nine packages chosen for this roundup offers better character recognition across a wider range of fonts than past offerings, and each does so for a list price within a $199 to $995 range.

Several of the packages also make headway in reducing the document entry process to a quick, painless task. Most of them make it their business to reproduce not only the text from the printed page, but also the layout of the page and even the font in which it was printed. Frequent and occasional users alike will also find a few other new developments that should make OCR a tempting technology, including the ability to scan, recognize, and load text directly and automatically into applications.

BETTER RESULTS, CHEAPER PLATFORM

Given its near-universal utility, one has to wonder why PC users have not yet universally embraced OCR. An important piece of the explanation lies with the software's traditionally weak performance; recently we've seen a vast boost in the capabilities of these packages. When *PC Magazine* last reviewed optical character recognition software two years ago ("OCR Software Moves into the Mainstream," October 30, 1990), the top packages performed well with monospaced fonts and 12-point proportional fonts, but even the most accurate of the lot—WordScan Plus—proved virtually useless for proportional fonts 10 points and smaller. In sharp contrast, even the least accurate package reviewed here produced usable results on the same text.

A significant drop in the cost of required hardware also plays a key role. Like the two Editors' Choice winners of our last OCR roundup—OmniPage/386 and WordScan Plus—each of the products in this roundup runs under Microsoft Windows, requires at least 2MB of RAM (or the manufacturer recommends at least this amount), needs about 6MB of hard disk space, and consumes plenty of processing power. But the cost of an appropriately equipped 25-MHz 386 and an accompanying gray-scale page scanner has fallen considerably, typically by about 30 to 40 percent. More important, many corporate users already work with such hardware or have access to it.

THE FIELD

A well-learned lesson from our last OCR roundup was the relative inferiority of packages that depend solely on *pattern matching* (also referred to as *template matching* or *matrix matching*). This technique recognizes characters by comparing the character's bitmap, pixel by pixel, to a database of each possible character. Given the necessity of a close match, such systems require that you train the package for each new font it must recognize, a laborious process that involves entering the correct value of each character image as the program presents them on the screen.

Therefore, our foremost requirement for the packages reviewed in this story was *omnifont recognition*—the ability to recognize a wide range of fonts without training. Most of the packages reviewed here utilize a technique called *feature extraction*, which matches an image to the appropriate character by looking for certain qualities of each character—the complete circle of the letter *o*, for example. Whatever the basic algorithms, each vendor adds additional means of improving accuracy, including possibilities such as context checking through use of a lexicon.

We also required that the packages support image recognition of 400 dots per inch, either through direct scans or in images scanned externally. Both OCR and scanner vendors seem to have settled on 300 dpi as the optimal cost/performance resolution for these packages, and in most

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cases, 300 dpi does seem to suffice: Jumping to 400 dpi may slow processing considerably, depending on the amount of RAM your system is using, and it can even decrease accuracy by increasing the amount of noise in the scanned image. On the other hand, with smaller point sizes—certainly those below 7 points—400-dpi scanning may prove imperative, as PC Magazine Labs' performance tests clearly show. OmniPage Professional, for instance, made 59 errors on 6-point Times Roman at 300 dpi but only 12 errors on the same sample at 400 dpi.

The last two requirements for each package were that they be capable of automatic page decomposition—eliminating graphical elements and collapsing multicolumn text into correctly ordered, single-column text—and carry a list price of less than $1,000.

Coincidentally, the nine survivors all run under Microsoft Windows. We tested them using Windows 3.0, but all except OmniPage 386 should run under Windows 3.1; the only difference in performance will be an increase in speed, according to the companies. By the time you read this, Version 3.2 of OmniPage 386, which is compatible with Windows 3.1, should be available. OCR Systems also plans to release a new version of ReadRight for Windows that it says is far superior to the old.

Two packages that nominally met our selection criteria dropped out for other reasons. We eliminated TextPert, from CTA, primarily because it is geared more toward inputting structured documents, such as forms; it also crashed frequently during preliminary testing. ReadStar 6, from Inovatic, provides a wealth of features but simply lacked the graphics prowess of its competitors. To mark a text region manually with ReadStar 6, for instance, you must enter coordinates for the region outline rather than simply expand a box to surround the text on-screen.

PC MAGAZINE

EDITORS' CHOICE

- **OmniPage Professional, Version 2.0**
- **WordScan Plus, Version 1.1**

Selecting the Editors' Choice for OCR software was a refreshingly difficult decision: Each of the products has at least one unique strength that makes it worth your consideration. OmniPage Professional, Version 2.0, stands out for its superlative performance. Its throughput reached almost 2,000 correct words per minute during PC Magazine Labs' testing—on all but the most degraded documents. The interface isn't perfect, but beneath that imperfection lie powerful tools for proofing your output and the ability to substitute aliases for nonstandard characters. At $995, it is also a bit pricey.

For those who don't mind trading speed for dollars, the other Editors' Choice winner, WordScan Plus, Version 1.1, offers similar flexibility for handling multiple documents, a more polished interface, and comparable accuracy for $695. And if you need to process a lot of draft-quality dot matrix documents or want to input the occasional fax, only the more expensive TypeReader surpasses WordScan Plus.

Two products deserve honorable mention. The $995 price for TypeReader, which matches WordScan Plus on throughput, is the only thing that kept it from receiving an Editors' Choice; this package is as good as WordScan Plus but is not quite up to OmniPage Professional's power and accuracy. But it does beat both on clarity of interface design, flexibility when handling multiple documents, and degraded-document recognition. Bargain hunters should seek out WordScan, a $295 version of its faster, more powerful big sister.

Packages such as OmniPage Direct and TypeReader deserve special note for their near-complete format retention, a feature that can significantly reduce the amount of time it takes to reproduce a document from the printed page. OmniPage Direct should also prove an enticing choice for many general-office applications, given its ability to link itself to Windows applications, though buyers of this package will have to accept a trade-off in terms of other features.

Whether you need a traditional OCR package or not, you might consider Calera's $149 FaxGrabber if you use a fax board: FaxGrabber applies the same capable OCR algorithms used in the WordScan products to convert incoming faxes to text transparently.

On clean documents with simple layouts, Recognita Plus (Americas version) comes close to OmniPage Professional in both speed and accuracy, but its repertoire is more limited than its $595 price tag—or the $495 tag on the English version—justifies. At $295, Perceive isn't a bad package for performing recognition on clean documents with simple layouts, but it is the slowest product we reviewed. And with luck, the forthcoming version of ReadRight for Windows will clean up the current version's page decomposition problems.

ONE STEP AT A TIME

The OCR process can be broken down into a few broad tasks: input, decomposition, character recognition, and proofing. First, the package must receive the bitmap, either by scanning documents directly—driving a desktop scanner from within the software—or by loading a previously scanned image file, usually in TIFF. Infrequent OCR users probably need concern themselves with only a couple of features here: the maximum resolution the package supports, both for direct scans and TIFF files; and whether the package supports Hewlett-Packard's AccuPage or provides its own technology to allow easy recognition of text with shaded backgrounds. (For more information, see the sidebar "AccuPage and AnyPage: Two Technologies for Better OCR.")

Flexibility when handling both direct scans and TIFF files is important for high-volume, single- or multiple-user applica-

▶ SUMMARY OF FEATURES

OCR Software

PC EDITOR'S CHOICE

Products listed in alphabetical order

■ = YES □ = NO

	OmniPage Direct	OmniPage Professional	OmniPage 386	Perceive	ReadRight for Windows	Recognita Plus (Americas version)
List price	$595	$995	$695	$295	$199	$595
General						
Interface:						
Function keys	□	□	□	□	□	■
Icon bars	■	□	□	■	■	■
Keyboard shortcuts	■	□	□	■	■	■
Pop-up menus	□	■	□	■	■	■
Pull-down menus	□	■	□	■	■	■
Memory required	4MB	4MB	4MB	2MB	535K	512K
Minimum hard disk space required	8MB	8MB	8MB	4MB	6MB	3MB
Batch processing from DOS prompt	□	□	□	□	□	■
DDE support	■	■	□	□	□	□
OCR Characteristics						
Rated point sizes	6–72	6–72	6–72	8–36	6–72	6–24
User must specify fixed or proportional spacing	□	□	□	□	□	□
Number of characters in recognizable character set	142	142	142	176	255	151
Incorporates dictionary into recognition process	□	□	□	□	■	□
Reads foreign characters	■	■	■	■	□	■
Character training:						
During recognition	□	■	□	■	□	■
As a separate process	□	□	□	■	□	□
Trains dot matrix characters	□	□	□	■	□	□
Scanning Features						
Maximum supported scan resolution	300 dpi	400 dpi	400 dpi	600 dpi	400 dpi	400 dpi
Adjustable brightness (manual/automatic)	■■	■■	■□	■□	■□	■□
User can preview scanned image	■	■	■	■	■	■
User can adjust position/size of scan window	□□	□□	□□	□□	■■	■■ (margins only)
Adjustable dithering	■	■	■	□	□	□
Color recognition	□	□	□	□	□	□
Fax-card driver	■	■	□	□	□	□
User-definable page size	□	■	□	■	■	■
Saves and loads user profiles	□	■	■	■	■	■
Page Recognition						
Automatic page decomposition	■	■	■	■	■	■
Maximum number of columns	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	64
User can specify number of columns	■	■	■	□	□	□
Force to single column	■	■	■	■	■	■
Manual page decomposition:						
Alters automatic zoning	□	□	■	■	■	□
Deletes or alters regions after character recognition	■	□	■	□	■	□
Templates	■	■	■	■	■ (one zone only)	■

N/A—Not applicable The product does not have this feature

TypeReader	WordScan	WordScan Plus (PC Editors Choice)
$895	$295	$695
■	□	□
■	■	■
■	■	■
■	□	□
■	■	■
4MB	2MB	2MB
7MB	6MB	6MB
□	□	□
□	□	■ (Word for Windows only)
5–64	6–28	6–28
□	■	■
114	108	108
■	■	■
□	■	■
□	□	□
□	□	□
□	□	□
300 dpi	400 dpi	400 dpi
■■	■■	■■
□	■	■
□■	■■	■■
N/A	■	■
□	■	□
□	□	□
■	■	■
■	■	■
■	■	■
Unlimited	Unlimited	Unlimited
□	□	□
■	■	■
■	■	■
■	□	□
■	■	■

CONTINUES

tions. While every package can accommodate one file at a time, with each file corresponding to a single scan of a single page, all but three of the packages provide a means—called deferred processing—to handle the task in streamlined, batch fashion, saving all pages for one job in one file. The control each of the packages offers within this framework also varies considerably. Some packages allow you to save a file for deferred processing at any point along the way—after scanning, after page decomposition, and even after recognition.

Other important document-handling features include the ability to process multiple jobs automatically while sending the output for each job to separate files. Most of the reviewed packages handle this with a blank-page separator: They interpret a blank page or blank TIFF file as a job delimiter and save separate files for each job. Some of the packages can also separate multipage jobs by individual page or input file.

Finally, most of the packages allow you to save current option settings for later use and can automatically reorder output to handle two-sided documents.

Once the package has loaded the bitmap, it will either wait for you to mark areas of the page that contain the text to be recognized, or (more important) automatically find and order the text for you. None of these packages has much of a problem finding the text, which includes identifying and eliminating graphical elements (several of the packages offer the capability to save graphical images to separate files).

The more difficult part of the job, appropriately dubbed *decolumnization*, involves determining the order in which the text is meant to flow. A typical page of two- or three-column text will often work without a hitch, but a four-column page with a headline and an embedded center graphic can be a real challenge, even for the best performers. With a page this complex, you will probably get the job done more quickly—and with less grief—if you mark the regions manually.

For those times when automatic decomposition does not quite go off as well as you would hope, the better packages provide a manual means to alter, reorder, or do both to the regions the program came up with, without having to make a new scan. A final decomposition feature, templates, allows you to designate the regions and save them for use with similar documents. This option allows the quick elimination of page elements such as headers, footers, page numbers, or paragraph numbers.

PROOF IT

No matter how capable a package is at character recognition and decolumnization, its proofing features can greatly affect its throughput—the number of words per minute the package can process accurately.

When an OCR package cannot recognize a character, it inserts a marker, usually a tilde or another specified character, in its place. Most of the packages provide a way of jumping to the next marker, either by a dedicated key or through a generic search feature. Most also provide spell-checking and support the use of one or more customizable dictionaries to supplement the primary lexicon. The better packages will show you—via a verification window—a slice of the bitmap so that you can determine visually what the character should really be. How a package implements each of these features can be nearly as important as whether it supports a given feature at all.

TypeReader, for example, lets you jump to the next illegible or suspect character simply by hitting the Tab key, placing it among the fastest packages for correcting suspect characters. But instead of moving the cursor to each misspelling for you, TypeReader's spell-checker only highlights words it cannot find in the dictionary, a shortcoming that lands it among the poorer performers on our proofing tests.

The amount of formatting retained by the package will also affect its speed. When outputting to word processor formats, all but two of the packages reviewed here at least attempt to retain character enhancements such as boldface, underline, and italics. Some go further, enabling you to duplicate the document all the way down to font and page layout.

THE RIGHT MIX

Given the difficulty of predicting just what sort of document might present itself for recognition on any particular day, one can hardly overstate the importance

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CIRCLE 248 ON READER SERVICE CARD

▶ SUMMARY OF FEATURES

Products listed in alphabetical order ■ = YES □ = NO	OmniPage Direct	OmniPage Professional (PC Editors' Choice)	OmniPage 386	Perceive	ReadRight for Windows	Recognita Plus
Page Recognition (continued)						
Reads mixed graphics and text	□	■	■	■	■	■
Ignores graphics	■	■	■	■	■	■
Save graphics to separate file	□	■	■	□	■	□
Specifies region contents	□	■	■	□	■	■ (entire page only)
Alphabetic	N/A	■	■	N/A	■	□
Alphanumeric	N/A	■	■	N/A	■	■
Numeric	N/A	■	■	N/A	■	■
Graphics	N/A	■	■	N/A	■	□
Custom (editable zone files)	N/A	■	■	N/A	■	□
Output Characteristics						
Retains page layout in applicable output formats	■	■	□	□	■	■
Stylesheets for output	N/A	□	□	□	□	□
Retains columns	■	■	■	■	■	■
Retains character formatting:						
Boldface	■	■	■	□	■	□
Underline	■	■	■	□	■	■
Italics	■	■	■	□	■	■
Superscripts and subscripts	□	□	□	□	□	□
Converts spaces to tabs	■	■	■	■	■	■ (not in ASCII file)
Hard carriage returns	■	■	■	■	■	■
Paragraph markers	■	■	■	■	■	■
Line spacing	■	■	■	■	□	■
Prints recognized text and graphics	N/A	■	□	□	□	□
Proofing						
User-definable substitution character	■	■	■	■	■	■
Jumps to substitution character	□	■	■	■	■	■
Bitmap verification window	□	■	■	□	■	■
Zoom levels	None	None	None	Depends on file size	None	5
Spell-checker	□	■	■	□	■	□
Suggests replacements	N/A	■	■	N/A	■	N/A
Automatic spell-checking/ replacement	N/A	■■	■■	N/A	□□	N/A
Foreign-language dictionaries available	N/A	■	■	N/A	□	N/A
User-defined dictionary	N/A	■	■	□	■	□
Edit within program	N/A	■	■	N/A	■	□
Import/export	N/A	■□	■□	N/A	□□	□□
Supports multiple user dictionaries	N/A	■	■	N/A	□	□
Text editor	□	■	■	■	□	■
Block moves	N/A	■	■	■	N/A	■
Search-and-replace	N/A	■	■	■	N/A	■
Boldface	N/A	■	□	□	N/A	□

N/A—Not applicable: The product does not have this feature.

TypeReader	WordScan	WordScan Plus (PC Editors' Choice)
■	■	■
■	■	■
□	■	■
□	■	■
N/A	□	□
N/A	■	■
N/A	■	■
N/A	■	■
N/A	□	□
■	■	■
□	□	■
■	■	■
■	■	■
■	■	■
■	■	■
■	■	■
■	■	■
■	■	■
■	■	■
■	■	■
□	□	□
■	■	■
■	■	■
■	□	■
2	None	None
■	■	■
□	□	□
□□	■□	■□
□	■	■
■	■	■
□	■	■
■□ (ASCII file)	■■	■■
■	■	■
■	■	■
■	□	□
■	■	■
□	■	■

CONTINUES

of choosing a package that will prove capable across a wide range of materials. Unfortunately, even the better of the nine packages reviewed here can suffer from blind spots, such as draft-quality dot matrix print, small fonts, landscape text, or degraded photocopies. Before you buy, peruse PC Labs' test results to ensure that the package of your choice will handle these jobs if your application requires them.

For high-volume applications, speed and document-processing options should carry as much or more weight as character accuracy beyond a given, acceptable threshold. Particularly for archival operations, for instance, the difference between five errors per page and ten may be trivial, especially if fuzzy search capabilities will be applied.

Finally, real differences exist between these packages when it comes to format retention and ease of use. A key feature for one application—the insistence of OmniPage Direct and TypeReader on retaining the document's layout, for instance—may constitute a considerable liability in another.

If you're only half sold on the idea of OCR or you need it very seldom, a handscanner/OCR combination might be the place to start (covered in the sidebar "OCR on the Cheap"). Whatever your needs, at least one of the products reviewed in the following pages will probably fill them quite nicely. OCR will no doubt continue to get better, but these latest products drive one point home with impressive certainty: When it comes to document input, manual entry alone just doesn't make sense any longer.

OmniPage Direct
OmniPage Professional
OmniPage 386

BY EDWARD MENDELSON

Caere Corp.'s $995 OmniPage Professional works faster than any other OCR software available for the PC, and more accurately—as long as you feed it reasonably clear documents. It gets most jobs done easily and efficiently, and with some OCR tasks, especially those that involve nonstandard characters or unusual fonts, OmniPage Professional may be the only package that can get the job done at all.

OmniPage comes in three flavors, all Windows-based. The full-featured OmniPage Professional, now in Version 2.0, includes deferred processing, spell-checking, and software training to recognize special symbols. The $695 OmniPage 386,

SUITABILITY TO TASK

OmniPage Professional

	POOR	FAIR	GOOD	EXCELLENT
Occasional OCR	●	●	●	○
Frequent OCR	●	●	●	●
Complex page layouts	●	●	●	○
Poor-quality documents	●	○	○	○
Foreign languages	●	●	●	○

Version 3.1, omits these features, and it also lacks AccuPage support for HP scanners and various conveniences, such as the ability to assign text attributes like bold and italics to scanned text.

Caere eventually expects to phase out OmniPage 386 in favor of the new $595 OmniPage Direct, Version 1.0, which sends scanned output directly to your word processor instead of including proofing and editing tools of its own. OmniPage 386 and OmniPage Professional work only in Windows' 386 Enhanced mode; OmniPage Direct includes two OCR engines, one for Enhanced mode and the other for standard mode, and it automatically switches to the standard-mode engine if you're running it on a 286. An earlier manifestation of Caere's technology, OmniPage/386, was a *PC Magazine* Editors' Choice in 1990.

OmniPage Professional's interface is partly straightforward, partly awkward. If you don't need to change the program's current settings, you can start scanning and processing by choosing Quick Scan and then interact with the program only when you need to edit or save your files. If you need to change any options, one Scan menu presents most of the choices you need.

Some options seem especially confusing until you memorize their meaning. For example, under the Scan menu, you choose Manual Block Selection if you want to change the order and content specification of the zones the program automatically identifies on the page—not if

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Perceive Personal 2.0 for Desk Top Scanners

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MicroPhone II 2.0 $94

Link your computer to other personal computers, minicomputers, mainframes, information services and bulletin boards with MicroPhone II 2.0. Whether you want to want to transfer a file, send electronic mail or download the latest stock quotes, you can feel secure with this fast and easy Windows program.
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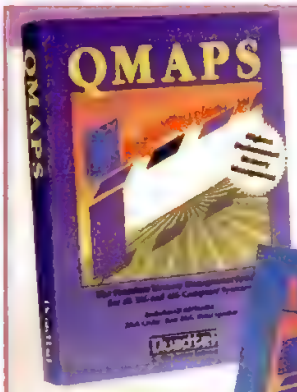

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QMAPS version 2.1 now offers up to 40% more upper memory and better compatibility with Windows 3.1. Automatically load and configure TSRs and drivers with SMARTMOV (included). Also included are the QUADTOOLS RAMdisk, disk cache and spooler, as well as the Quadtel EASY network license. Quadtel • #07859

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New WordPerfect for Windows offers a new graphic interface which allows you to make graphic enhancements you can't make in character-based environments. The new WYSIWYG feature lets you view your scaled fonts and graphics. Other features also make operation a breeze. Upgrade price requires proof of ownership of a competing product. WordPerfect
• #07009 - 5.25" disk • #07011 - 3.5" disk

Alpha Four 2.0
Competitive Upgrade

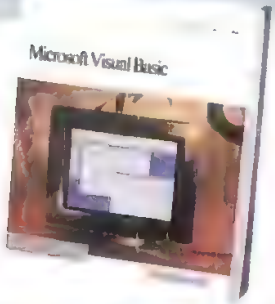
$94

Manage your database and develop powerful applications with the same software package. Even if you don't know programming, Alpha FOUR 2.0 lets you program with ease. Upgrade price requires proof of ownership of a competing product. Alpha Software • #07476

Lotus SmartSuite
Upgrade

$358

All the applications in SmartSuite are designed to work together in Windows so you can pass information from one program to another effortlessly. Lotus 1-2-3, Freelance Graphics design, Ami Pro word processing and electronic messaging with cc: Mail are all included. This upgrade software requires SmartSuite to run. If you own a previous version of any individual program included in SmartSuite, you can upgrade to the whole SmartSuite package at this special price. Lotus #10737-5.25" disk • #10738-3.5" disk

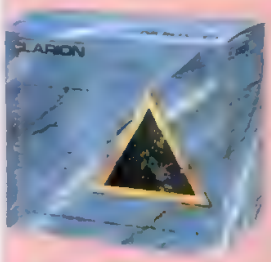


Microsoft Visual Basic
Competitive Upgrade

$98

Microsoft VisualBasic, the critically acclaimed programming solution for Windows, is now available at an incredible upgrade price. If you are currently using Actor, Smalltalk, Borland C or Pascal, then you're eligible.Upgrade price requires proof of ownership of a competing product. Microsoft Corp.
• #07759 - 5.25" disk • #07984 - 3.5" disk

Microsoft Professional Toolkit for Visual Baisc
• #10598 ..... $94



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Clarion Professional Developer
Competitive Upgrade

The Clarion Professional Developer's fast, user-friendly interface lets you create powerful applications in about half the time. It combines the convenience of state-of-the-art 4 GL/CASE tools with a rich procedural language, and more. Its everything an applications developer would ask for Upgrade price requires proof of ownership of a competing product. Clarion • #10986

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Microsoft Windows 3.1
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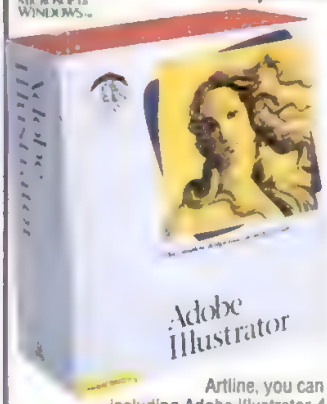
New! Windows Version 3.1 makes your PC easier to use. Use the improved Setup that automatically loads Windows onto your system and maintains your current configuration. New 3.1 prints faster with TrueType font technology so your output will look its best. ATM included, all for this super-low upgrade price! Microsoft Corp.
• #10636 - 5.25" disk • #10637 - 3.5" disk



Adobe Illustrator 4.0
Competitive Upgrade

$188

Design with the latest enhanced version of Adobe Illustrator, upgraded from your current design program. If you currently use CorelDRAW, Micrografx Designer, Aldus Freehand for Windows, Arts & Letters Graphics Editor, Harvard Draw, or Artline, you can receive this package including Adobe Illustrator 4.0, Adobe Type Manager, Adobe TypeAlign, Adobe Separator, 40 Type1 fonts and a stock of Adobe artwork. Upgrade price requires proof of ownership of a competing product.Adobe • #07785-5.25" disk • #10792-3.5" disk

Quattro Pro 4.0
Competitive Upgrade

$88

Quattro Pro 4.0 now offers advanced spreadsheet analysis tools, unsurpassed network support and superior database access. It combines built-in push-button power with revolutionary new Intelligent Graphs function that allows you to perform extended graphic analysis without changing your data. Upgrade price requires proof of ownership of a competing product.Adobe Borland • #07646

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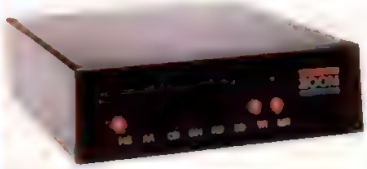

ZOOM AMX 2400bps External Modem $68

This full-featured external drive features V.42bis compression, letting you transfer data at speeds up to 9600 bps. It comes in a compact case about the size of a paperback book, leaving space on your desktop for other things. Modem activity is reported by eight status lights. Compatible with any computer, 7 year warranty. ZOOM Telephonics • #10649

SKU	TYPE	DESCRIPTION	PRICE
#09336	FC9624	ZoomS/R FAX Int.	$119
#09332	HC2400R	Zoom 2400 Int.	$68
#10648	VPV32	Zoom 9600 Int.	$248
#10646	VPV.32bis	Zoom 14.4 Int.	$268

Turn Your Desktop Into A Creative Lab

Video Blaster $344

This high-powered video card integrates video and audio sources from a video disc, VCR or camera, and combines them with VGA graphics to create a brand new world of multimedia presentations. Digitize and capture video images from these sources through the Video Blaster for use with other programs, presentation or even animation. Creative Labs #10728

Sound Blaster Pro $188

SoundBlaster's FM sound generation produces authentic-sounding instruments comparable to expensive professional synthesizers. And SoundBlaster Pro offers the largest support from multimedia, music, education and entertainment software developers under DOS and Windows. Creative Labs • #09919

KX-P2180 9-Pin Dot Matrix Quiet Printer $178

Get all the features you need for home and school, but with a dramatically lower noise level than most dot matrix printers. Its advanced features and more than 23 different functions make it versatile and easy to use. Panasonic • #07946

SKU	TYPE	DESCRIPTION	PRICE
#07944	KXP2624	24 pin quiet printer	$448
#07945	KXP2123	24 pin Quiet Printer	$274

ViewSonic 4E Super VGA 14" Monitor $328

The ViewSonic 4E Super VGA is an ideal multi-frequency, non-interlaced color monitor for your home or office computer. At 640x400 resolution, the 70Hz refresh rate provides you with a flicker-free screen, no glare or distortion. Utilizing a 0.28 dot pitch means your text and graphic images are clean, crisp, and razor-sharp. Includes up-front controls, non-glare screen, and tilt and swivel base. KeyPoint • #07967

Excite Your Senses With Multimedia

Pro AudioSpectrum 16

$228

This professional mutimedia sound board is the latest of its kind. It offers true 16 bit stereo sound—playback, input and sampling. Compatible with the most popular sound software available, it also comes with extra bundled software; a MIDI sequencer, four track sampling application and more. Media Vision • #10568

CDPC Multimedia Console $1098

The CDPC is the first fully integrated multimedia component system for the PC format. This innovative unit includes the electronics of the Pro AudioSpectrum 16, a high performance CD-ROM drive, high quality speakers and a 100 watt music amplifier to power it all up Media Vision • #10571

SKU	DESCRIPTION	PRICE
#10572	ThunderBoard for Windows	$114
#10570	Port.PC Sound AudioPort	$148
#10567	Multimedia MPC Int Upgr Kit+	$864
#10566	Pro Audio Spectrum Plus	$198

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#07446	4Mb x 4 x 9 80ns Micron	$698
#08228	1Mb*9 Simm(1) 80ns for PC	$48
#07488	1Mb*9 Simm(1) 70ns for PC	$48
#07489	1Mb*9 80ns Sip	$57

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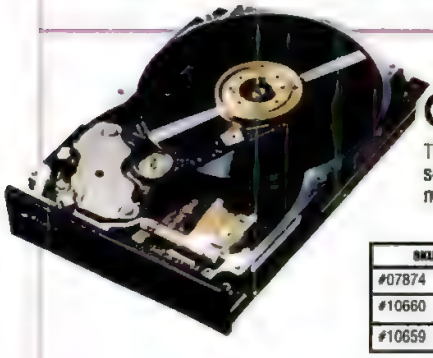
Maxtor Hard Drive $398

Unsurpassed performance and design characterize Maxtor's family of 1-inch high, 3.5-inch hard disk drives. Available with either an AT or SCSI controller, this 130MB model is ideal for use in mobile or desktop computer systems. Firmware control allows reduction of power consumption to just 0.1 watt. Other features include 150,000 hour MTBF, 64K cache, 1:1 interleave, automatic actuator lock, embedded servo, and high performance rotary voice coil. Maxtor • #10665

SKU	MODEL #	FORMATTED CAPACITY	AVERAGE ACCESS	DRIVE SIZE	PRICE
#10661	MXT-7080A	80.7MB	17ms	3.5"/1" high	$298
#10665	MXT-7120A	130.4MB	15ms	3.5"/1" high	$398
#10662	MXT-7213A	213.0MB	15ms	3.5"/1" high	$618
#10663	MXT-340A	340.0MB	15ms	3.5"/1.625" high	$998
#10664	MXT-340S	340.0MB	13ms	3.5"/1.625" high	$998



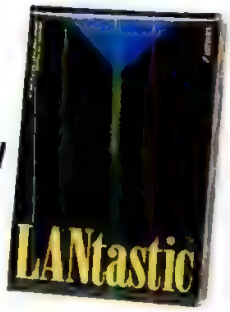
Seagate Hard Drive $398

The Seagate ST3144 is a 131Mb model with 32Kbytes SeaCache buffer. This unit features the advanced dedicated servo design with thermal compensation and a patented straight arm actuator with magnetic lock. With a 16 millisecond average seek, the ST3144 offers top performance and value. Seagate • #10660

SKU	MODEL #	FORMATTED CAPACITY	AVERAGE ACCESS	DRIVE SIZE	PRICE
#07874	ST-3120A	106MB	15 ms	3.5"/1" high	$338
#10660	ST-3144A	130.7MB	16ms	3.5"/1" high	$398
#10659	ST-3283A	245.3MB	12ms	3.5"/1" high	$754

Where Power Is Shared: The LAN Zone

One of the newest developments of information systems for power-using businesses is the installation of a Local Area Network, or LAN. Functioning much like a server, a LAN lets connected PCs access shared information. But a LAN has many advantages. It allows PCs to function as peers, able to use each others full functions from any unit on the connected system. Any PC accessing the LAN also has full use of all connected peripherals, as if it were connected to them directly . A Local Area Network can also be accessed from a remote PC not on the network; even one connected to another LAN in another city (via modem). the configurations of a LAN are almost limitless. And the benefits of sharing information in a peer-to-peer fashion will have you wondering how you ever did business without one.



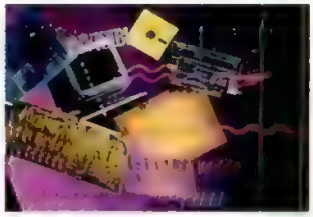
LANtastic EN Starter Kit #142 4.1 $488

Run your IBM PCs, XTs, ATs or compatibles on a LANtastic network. LANtastic uses small memory overhead—less than 12K on a node. The package includes two AE2 Ethernet cards, cables and network software. Fully Windows compatible.
ArtiSoft • #07969

LANtasticEN Adapter Card #143
• #09133 ..... $208
LANtasticZ Two Station 4.1
• #07968 ..... $88

Xircom Simplicity Starter Pack $668

Novell's Netware Lite is the software, and Xircom's pocket ethernet adapters are the hardware. Together, this package gives you everything you need to simply network two PCs whether they are laptops, notebooks or desktop types. The software guides you through complete installation and configuration. Includes E-mail and Novell's Netware Lite. Xircom
#10729-5.25" disk • #10731-3.5" disk



Invisible Network Ethernet Starter Kits $418

This is one of the fastest peer-to-peer networks on the market. The Invisible Network Starter Kit includes 2 adapter cards, 25 feet of coaxial RG58 A/U cable, 2 terminators, 2 T connectors, software & hardware user's manual. This means you get an instant network on receipt. The package even includes our award-winning Windows 3.0/3.1 graphical network interface, allowing unmatched functionality within Windows 386 Enhanced or Standard mode of operation. Invisible Software
#11048-5.25" disk • #11049-3.25" disk

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▶ SUMMARY OF FEATURES

Products listed in alphabetical order ■ = YES □ = NO	OmniPage Direct	OmniPage Professional (PC Editors' Choice)	OmniPage 386	Perceive	ReadRight for Windows	Recognita Plus
Proofing (continued)						
Underline	N/A	■	□	□	N/A	□
Italics	N/A	■	□	□	N/A	□
Superscripts and subscripts	N/A	□	□	□	N/A	□
Undo	N/A	■	□	□	N/A	■
Document Handling						
Double-sided documents (with sheet feeder)	□	■	■	□	■	□
Deferred processing	□	■	□	■	■	□
After image scan	N/A	■	N/A	■	■	N/A
After zoning	N/A	■	N/A	■	■	N/A
Resumes partially completed tasks	N/A	□	N/A	□	■	N/A
Automatically saves file after recognition	□	■	■	■	■	□
Recalls text file after save	□	■	■	■	□	□
Processes multiple files in one job	□	■	■	■	■	■ (batch mode only)
Multiple-file output:						
By scanned page	□	■	■	■	□	■ (manually)
By scanned document via job separators	□	■	■	■	□	□
By input file	□	□	□	■	■	□
File Formats						
Text output formats:						
Ami Pro	■ (with macro)	■	■	■	□	■
ASCII:						
Comma-/tab-delimited	N/A *	■■	■■	□■	■■	□□
Hard carriage returns	N/A *	■	■	■	■	■
Paragraph markers	N/A *	■	■	■	■	■
DCA (Document Content Architecture)	N/A *	■	■	□	■	■
Microsoft Word	N/A *	■	■	■	■	■
MultiMate	N/A *	■	■	□	□	■
PFS:Write	N/A *	■	■	□	□	■
Q&A Write	N/A *	■	■	□	□	■
RTF (Rich Text Format)	N/A *	■	■	■	□	■
Windows Write	■ (with macro)	■	■	□	■	□
Word for Windows	■ (with macro)	■	■	□	□	□
WordPerfect	■ (with macro)	■	■	■	■	■
WordStar	□	■	■	■	■	■
Data output formats:						
.DBF	□	■	■	■	■	□
.WK1	□	■	■	■	■	■
.XLS	■ (with macro)	■	■	■	■	■

N/A—Not applicable: The product does not have this feature

* OmniPage Direct works inside Windows applications via a DDE macro

TypeReader	WordScan	WordScan Plus (PC EDITOR'S CHOICE)
□	■	■
□	■	■
□	□	□
■	■	■
■	■	■
■	■	■
■	■	■
■	■	■
■	■	■
□	■	■
■	■	■
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■	■	■

CONTINUES

you want to draw the blocks by hand. To draw blocks by hand, you choose Multiple Zones—even if you want to scan only one zone. Your choices apply to all pages in a stack unless you choose Interactive Mode, which lets you work with zones on each page.

If you choose, OmniPage Professional preserves basic formatting such as justification, bold, and italics in its output files. You can output files in most major formats, including .WK1, but files destined for Microsoft Excel are output in text format, not spreadsheet format. OmniPage Professional occasionally (but rarely) formatted PC Magazine Labs' spreadsheet test page with spaces instead of tabs between columns. This package uses a more recent version of Caere's formatting engine that seems more robust and also preserves more layout features such as font sizes. This technology will be incorporated in OmniPage Professional, Version 2.1, which is due late this spring.

OmniPage Professional lets you automate basic scanning tasks to an exceptional degree. You can scan a stack of pages and save each page to a separate file, or you can separate jobs with a blank page. You can also defer processing—although you can't interrupt processing and return to where you left off—and automatically save text and images to files in formats that you specify.

SPEED AND ACCURACY

On PC Labs' performance tests, OmniPage Professional produced the fastest scores of any package reviewed. Its performance was dramatically fast for scanning and recognition but also notably fast in terms of proofing. Its accuracy was outstanding with printed documents, laser output, and clean photocopies, but other packages produced more accurate results with degraded photocopies and dot matrix output. OmniPage Professional's error rate increased dramatically with 6-point type, especially when compared with that of TypeReader, Version 1.0; OmniPage Professional was also unable to find any text on one faint dot matrix page.

At the time of our tests, OmniPage Professional and OmniPage Direct were the only packages that used HP's AccuPage technology. They were therefore the only packages able to extract text

FACT FILE

OmniPage Direct, Version 1.0

OmniPage Professional, Version 2.0 (PC EDITOR'S CHOICE)

OmniPage 386, Version 3.1

Caere Corp., 100 Cooper Ct., Los Gatos, CA 95030; 800-535-7226, 408-395-7000; fax 408-354-2743

List Price: OmniPage Direct, $595; OmniPage Professional, $995, OmniPage 386, $695
Requires: OmniPage Direct: 286-based PC or better, 4MB RAM, 8MB hard disk space, DOS 3.1 or later, Microsoft Windows 3.0 or later, OmniPage Professional and OmniPage 386: 386-based PC or better, 4MB RAM (with permanent swapfile), 8MB hard disk space, DOS 3.1 or later, Microsoft Windows 3.0 or later (OmniPage 386 runs under Windows 3.0 only).
In Short: OmniPage Professional, Version 2.0, is the clear choice for industrial-strength OCR. It is faster and, as long as you feed it relatively clean copy, more accurate than any of its competitors.

456 ON READER SERVICE CARD

from shaded pages that other programs could read only after we experimented at length with their brightness settings. By the time you read this, however, AccuPage will also be supported by TypeReader, WordScan Plus, and perhaps other packages. (For more information, see the sidebar "AccuPage and AnyPage: Two Technologies for Better OCR.")

When you proof scanned text in OmniPage Professional's editor screen, you can click anywhere in the text and pop up a bitmapped image of the original page. This makes it simple to correct errors that even the program did not flag. The built-in spell-checker is powerful but awkward. You have to click the Spell button to restart the check after you type in a correction (you can't use a keyboard shortcut), and if the cursor is in the middle of a word when you restart, the program flags the end of the word as a misspelling. Caere claims that the spell-checker searches for replacement words by concentrating on probable recognition errors (like *c* instead of *e*), and this feature performed well when we tested it.

OmniPage Professional performs reasonably but not spectacularly when decolumnizing complex pages. It lets you specify zones manually after scanning, but it's not as easy to save a set of zones as a

▶ SUMMARY OF FEATURES

Products listed in alphabetical order ■ = YES □ = NO	OmniPage Direct	OmniPage Professional (PC Editors Choice)	OmniPage 386	Perceive	ReadRight for Windows	Recognita Plus
File Formats (continued)						
Graphics input and output formats:						
.BMP (Windows bitmap)	□	■	■	□	□	□
.IMG (GEM)	□	■	□	□	□	□
.MSP (Microsoft Paint)	□	■	□	□	□	□
.PCX	□	■	■	■	■	■
TIFF	□	■	■	■	■	■
Device Support						
Page scanners supported:						
Abaton	□	■	■	□	■	□
Advanced Vision Research	□	■	■	■	■	■
Agfa	□	■	■	□	□	■
Canon	□	■	■	■	■	■
Epson	□	■	■	□	■	■
Hewlett-Packard	■	■	■	■	■	■
Dynamic thresholding (with HP ScanJet IIc)	■	■	□	□	□	□
Howtek	□	■	■	□	□	■ (via HP emulation)
Microtek	■	■	■	■	■	■
Panasonic	□	■	■	■	■	■
Ricoh	□	■	■	□	□	■
UMAX	□	■	■	■	■	■
Documentation and Support						
On-line help	■	■	■	■	■	■
Paper tutorial	■	■	■	■	■	■
User manual	■	■	■	■	■	■
Technical support hours (E.S.T.)	9:00–8:00	9:00–8:00	9:00–8:00	11:00–9:00	8:30–6:00	11:00–5:00
Toll-free telephone number	■	■	■	■	□	■
BBS	□	□	□	□	■	□

template for use with a later scan as it is with TypeReader or WordScan Plus. OmniPage Professional, however, lets you specify that zones contain customized "zone contents," which are subsets of the normal character set—numbers, letters, and standard symbols that you select.

You can also make the program recognize nonstandard characters—for example, math and chess symbols—by scanning a training page that contains the symbols, and then entering a string for the program to use in the output in place of each symbol. You can't include these nonstandard characters in a customized zone-contents file (despite an illustration in the manual that suggests otherwise), but you can tell the program to check for them when it encounters unrecognized characters. A language option lets the program recognize accented characters used in the languages you specify, and you can buy dictionaries for spell-checking most European languages. (You don't get customizable zone contents or nonstandard characters with OmniPage 386 or OmniPage Direct.) A graphics editing module included only in OmniPage Professional lets you modify half-tone and gray-scale images.

If you need industrial-strength OCR, OmniPage Professional is probably the package with the greatest speed and accuracy. If you don't need to scan dark photocopies or faint dot matrix pages, you will value its unique strengths far more than you will complain about its minor annoyances. This isn't the perfect OCR package, but for most purposes, it is hard to find a better one.

Perceive

BY GAYLE C. EHRENMAN

With Perceive, Version 2.0, you get what you pay for. At $295, this package from Ocron won't give you all the bells and whistles of some of its pricier competitors, but you get a steady performer at a reasonable price. This package lacks dictionaries and sophisticated editing functions, but it is easy to use, flexible, and reason-

TypeReader	WordScan	WordScan Plus (PC MAGAZINE EDITORS CHOICE)
☐	☐	☐
☐	☐	☐
☐	☐	☐
■ (input only)	■	■
■	■	■
■	☐	☐
■	■ (via HP emulation)	■ (via HP emulation)
☐	☐	☐
■	■	■
■	■	■
■	■	■
■	☐	☐
■	■	■
■	■	■
■	■	■
■	☐	☐
■	■	■
■	■	■
■	■	■
■	■	■
9:00–8:00	10:00–8:00	10:00–8:00
■	☐	☐
■	■	■

ENDS

ably accurate on all but the toughest scans.

When last we reviewed Perceive, Version 1.0 ("OCR Software Moves into the Mainstream," October 30, 1990), our biggest complaints concerned its inability to decompose pages automatically and to maintain page formatting and character attributes. At that point, its interface was confusing at best. Version 2.0 addresses some but not all of these shortcomings.

The biggest change is a greatly improved interface, which now sports a toolbar and easily deciphered pull-down menus. Six icons cover the most commonly used features: Quick Scan (scan and recognize in one step), Detail Scan (scan only), OCR (recognize text), Zoom, and Auto Zone (page decomposition).

You can choose from three recognition modes: Omnifont, Learning, and Learned. In Learning mode, you train the software to recognize unfamiliar, standard keyboard characters by typing them in and saving them to a named font file. You select and add non-keyboard characters (like accented characters) from the extended character table. If you have Cyrillic, Hebrew, or other non-European display fonts installed on your system, Perceive will add those characters to the extended table so it can learn them as well.

SUITABILITY TO TASK

Perceive

	POOR	FAIR	GOOD	EXCELLENT
Occasional OCR	●	●	○	○
Frequent OCR	●	●	○	○
Complex page layouts	●	●	○	○
Poor-quality documents	●	●	○	○
Foreign languages	●	●	●	○

The other major change in this version of Perceive is the aforementioned addition of automatic page decomposition. You can select this feature via an icon after you've scanned a document, or choose it as a default from the settings menu. It is also from this menu that you specify the language or languages to be recognized in Omnifont mode (Perceive can read ten languages besides English), choose the scanner (the package supports a wide variety), and opt for deferred recognition. One particularly nice touch is that you can choose preferences and settings even after you've scanned a document and Perceive will automatically apply them. In addition, you can specify any settings you use frequently, including the recognition mode, and page orientation and OCR zones; you can save them to a named setup file (or template) you can recall.

SLOW BUT STEADY

What Perceive won't do is wow you with blinding speed; it finished in the middle to bottom of the pack on all of PC Magazine Labs' speed tests, lagging far behind the group leader, OmniPage Professional.

Issues of speed aside, Perceive turned out surprisingly accurate results on our recognition tests. It proved strong at recognizing 12-point type, consistently placing among the leaders on tests of single- and multiple-column scanned and prescanned documents. Its performance on our 8-point Helvetica sample was somewhat less impressive but still acceptable. Its performance on 8-point Times Roman, however, was far from adequate.

The package fared well at recognizing letter-quality dot matrix documents, as well as clean and lightly printed photocopies. As did the rest of the group, it didn't fare as well on dark copies and degraded fax documents, where it tried to read extraneous markings on the page as text.

Perceive did an acceptable job of recognizing automatically decomposed pages, as long as the layouts were relatively simple. For example, the package handled both a newspaper clipping and a two-column page of justified text with an image and a deck reasonably well, but failed miserably on a page with a circular photo embedded in two columns of text. This is only a minor shortcoming, though. When we manually zoned these pages for recognition, Perceive performed admirably. And since choosing the recognition zones or reorganizing them is a simple click-and-drag procedure, you don't lose much in the way of time.

One of Perceive's biggest shortcomings is its inability to specify the contents of a zone as either numbers or letters. Because of this omission, it produced unusable results on our spreadsheet test. The package also lacks all but the most rudimentary editing features. There is no built-in dictionary, so it can't distinguish

FACT FILE

Perceive, Version 2.0

Ocron, 3350 Scott Blvd., #36, Santa Clara, CA 95054; 408-980-8900

List Price: $295
Requires: 286-based PC or better, 2MB RAM (4MB recommended), 5MB hard disk space, DOS 3.3 or later, Microsoft Windows 3.0 or later, Windows-compatible pointing device recommended
In Short: While not the flashiest or the speediest, Perceive, Version 2.0, is a steady performer on all but the toughest scans. It may not be ready to give the category leaders a run for their money on features alone, but at $295 it is well worth your consideration

457 ON READER SERVICE CARD

OCR on the Cheap

by Angela Gunn

Human errors that are merely irritating when hand scanning graphics can be fatal when performing OCR work. Because the quality of the bitmapped image fed into the OCR software directly affects recognition accuracy, packages designed with hand-scanner support must correct for the most common problems—skew and inconsistent scanning speed (described in "Quick Graphics on a Budget: 12 Hand Scanners" in the November 12, 1991, issue of *PC Magazine*).

Most people who attempt to use hand scanners for OCR are initially drawn to the hardware's low price and then decide to give OCR a whirl.

There are several hand scanner–based OCR packages that do a creditable job. It is impossible to recommend these for a user who does a great deal of scanning, but occasional users will get a kick out of the functionality these packages add to their computers.

There are a few standards you should expect from these packages. Primary is omnifont recognition: Products that use pattern-matching algorithms are ineffective for hand-scanned images, since the images tend to be less consistent than those generated on a flatbed scanner and so require more "training" for the software. The software should accept both horizontal and vertical scans and have the ability to merge and decompose text blocks.

We came across four packages that fit these standards: Caere Corp.'s $595 Typist Plus Graphics (Los Gatos, California); Ocron's $195 Perceive Personal, Version 2.0 (Santa Clara, California); OCR Systems' $249 ReadRight Personal, Version 1.0PW (Huntington Valley, Pennsylvania); and Recognita Corp. of America's $195 GO-CR, Version 2.0 (Sunnyvale, California).

Of these products, Typist Plus Graphics is the only one sold as a bundle; it is actually software packaged with an excellent hand scanner from ALPS America. You load it as a TSR and then start your favorite word processor. When you're ready to insert scanned material, you hit the hotkey and go. This package is bound to be popular with any user who wants to scan simple documents directly into a particular word processor.

The three remaining packages have advantages for users who wish to manipulate their images more thoroughly; they are also a better option for those who already own a hand scanner. All the software-only packages offer installation options for hand scanners from Logitech, Marstek, Nisca, and The Complete PC. For our informal testing, we used Logitech's ScanMan 256.

These packages performed relatively well—given, that is, the limitations of the hand-scanning process.

WHAT'S UP FRONT

These packages primarily differ in interface design; the level of recognition is roughly equivalent. ReadRight Personal has a split-screen interface that leaves buttons labeled "Scan" and "Scan and Recognize" on-screen at all times. This package is unique in several respects. It is the only one that does not offer a real-time view of the scan; it instead waits until you've finished scanning to present the bitmapped image. It's also the only package that "caught" an incorrect dot-per-inch setting on the scanner itself. (OCR hand-scanning packages generally call for a setting of 300 dpi as an all-around optimal resolution for the widest variety of fonts.)

Perceive Personal has a spare but pleasant look, with a single row of radio buttons in addition to the pull-down menu bar. This is the only package that doesn't allow one-step scanning and recognition; once you have entered the bitmap into the system, you can review it and only then select the OCR button.

GO-CR has an icon-laden screen; virtually every option on the menu bar is represented visually along the top and left side of the work area. This package allows you to select the scan direction with each scan (the icons are a nice reminder for the forgetful). It is also easy to set options such as left-center-right column extraction, decolumnization, and text merge without going into the menus.

These packages performed relatively well—given, that is, the limitations of the hand-scanning process. For instance, hand scanners require two or three passes to catch all the text on a page; each package has some method for automatically stitching the passes together. For those scanning newsprint or other columnar information, GO-CR and Perceive Personal require you to indicate which section of text is to be recognized before you scan. ReadRight Personal, on the other hand, allows you to indicate the desired copy block while viewing the bitmapped image.

It's admirable that these vendors have come up with palatable workarounds, but truly complex recognition is exponentially more difficult for packages that are handicapped by their own hardware. Additionally, none of these packages allows training; the quirks of the packages' recognition algorithms are quirks you will have to live with.

OCR via hand scanner is an option for only the most occasional user, or for the user who already owns a hand scanner for graphics use. Once your scanning habit gets above one or two a day, it will be time to open your wallet for real and get a flatbed scanner. □

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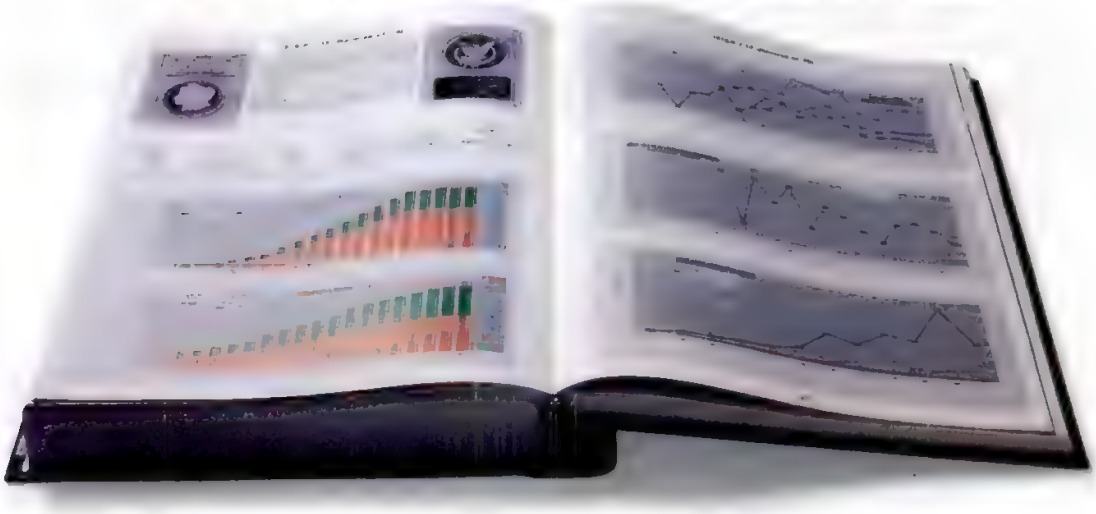

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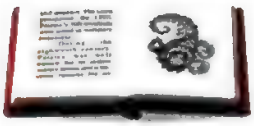

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CIRCLE 237 ON READER SERVICE CARD

improbable words. You can search and replace questionable characters and cut and paste copy, but that's it. You can't even go back to check on what words it may have missed; the package throws out the bitmap as soon as it has finished recognition. In addition, it makes no attempt to retain page formatting or character attributes.

Perceive, Version 2.0, may not be ready to challenge OmniPage or TypeReader on features alone, but it can put up a fight on the quality of its recognition. It's clearly not the top of its field, but at $295 it will give you your money's worth.

ReadRight for Windows

BY GARY BERLINE

At $199, ReadRight for Windows, Version 3.1, leads the OCR pack in price, but it lags far behind in performance and reliability. Inconsistencies and poorly implemented functions make this package capable of handling only the most simple, repetitive character recognition tasks.

When you scan a page or load a bitmapped file, an overview of the input appears in an image window. Text appears in an optional recognition feedback box as it is read; when the process is complete, the output is displayed in a document window. A magnification tool lets you enlarge the image window's contents, making it easier to outline recognition regions. Unfortunately, it offers only two zoom levels. Text remains unreadable at the lower setting, and the higher level puts it in pixel view, making it useful only for examining individual characters. You might expect scrolling to help you gain your bearings, but here it works at a lumbering gait.

ReadRight incorporates an error-correction module but no training facility. You can search for any combination of unrecognized, questionable, or misspelled words and choose to ignore words with all capital letters. There is only one user dictionary, though, and it doesn't work quite right. You can add words to it, but it will not stop you from adding the same word multiple times. In fact, it will continue to flag words after you've added them to the dictionary.

FACT FILE

ReadRight for Windows, Version 3.1

OCR Systems, 1800 Byberry Rd., #1405, Huntingdon Valley, PA 19006; 800-233-4627, 215-938-7460; fax 215-938-7465

List Price: $199
Requires: 286-based PC or better, 4MB RAM, 5MB hard disk space, DOS 3.1 or later, Microsoft Windows 3.0 or later, mouse.
In Short: ReadRight for Windows, Version 3.1, has the lowest price in the category but suffers from instability, poorly implemented functions, and lackluster performance. It handles tables, clean copy (without graphics), and multiple documents satisfactorily, but wait for the new version or look elsewhere if you have tougher OCR challenges.
458 ON READER SERVICE CARD

DEPRESSING DECOMPOSITION

On PC Magazine Labs' tests, ReadRight produced serviceable accuracy on clean files with simple layouts, but at a less than sprightly pace. The package did a good job of reading and outputting tables in Microsoft Excel and tab-delimited ASCII formats, and it produced usable output from our fax sample.

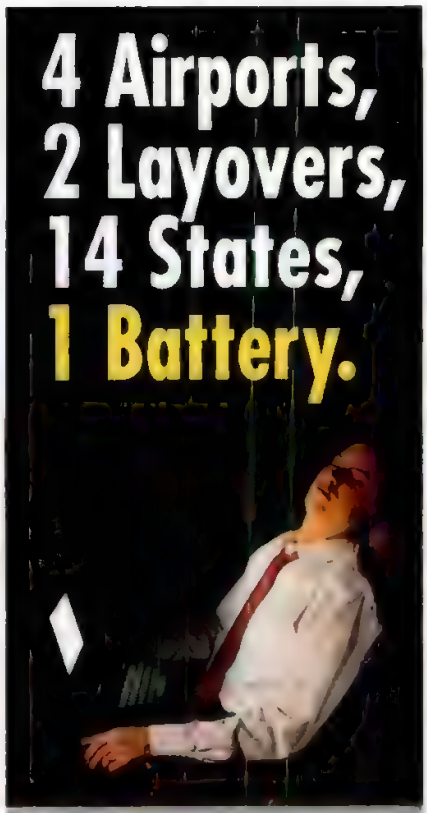
SUITABILITY TO TASK

ReadRight for Windows

	POOR	FAIR	GOOD	EXCELLENT
Occasional OCR	●	○	○	○
Frequent OCR	●	●	○	○
Complex page layouts	●	●	○	○
Poor-quality documents	●	○	○	○
Foreign languages	N/A			

The program wrestled itself to the ground, however, when it tried to decompose anything more complex than a two-column, text-only document. On samples of 6-point type, ReadRight initially failed to discern anything as text except the headlines. The 10-point copy set in double columns under straddle heads ended up side-by-side rather than contiguous. OCR Systems provided a patch that cured these troubles but produced extraneous hyphens in output from the dual-column pages. Nothing, however, persuaded the package to decolumnize properly even the simplest page containing graphics.

In fact, the product regularly zones graphical areas as text and then attempts to read them. After several minutes, this



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futile attempt produces a "Problem Recognizing Image" message. Adjusting the scanner brightness sometimes corrects the problem, but at the expense of dramatically poorer text zoning.

Worse than its inaccuracy is ReadRight's instability. Automatic page decomposition failed multiple times on the same image, again after a reboot, and then—after yet another boot—suddenly worked. Exiting the package and then running another Windows application often resulted in an "Insufficient Memory to Run Application" message—a Windows problem exacerbated because ReadRight uses more dynamic link libraries than other applications do. Annoyingly, ReadRight insists on automatically concatenating output; any save to a file stores everything you've processed since the last time you closed the document window in a single file—a convenience only if that's what you want and a headache otherwise.

Certain areas of the program, including multiple-document processing, show a bit more polish than others. ReadRight can automatically scan a stack of pages, storing the image for each into a separate file. If it hits a blank page, though, the program stops and alerts the user. Starting the next job requires human intervention. You can easily create a template of common settings to make the scanning and recognizing process more efficient. The program offers a wide variety of choices for preserving text attributes, including the font type and point size. Defining and renumbering regions requires little effort.

A new, reengineered version of ReadRight for Windows scheduled to ship this summer will correct many of the problems associated with Version 3.1, says the company. Until then, it remains a product for users on the tightest of budgets with clean, simple, and relatively similar documents to process.

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CIRCLE 321 ON READER SERVICE CARD

Recognita Plus

BY GARY BERLINE

Recognita Plus, Version 1.2, is like a four-lane highway that ends in a field. The product, from Recognita Corp. of America, makes an excellent first impression, but surprising limitations leave you wondering if somebody forgot a disk or two. At a list price of $595, the version we tested—The Americas OCR—comes closer to high-end packages on price than features. The company sells an English-only product for $495 and one with more extensive language support for $795.

The software runs quickly yet demands little, bringing real OCR capability to a broad range of platforms. The Windows version can operate on 286-based systems, and the DOS version bundled with it can load into 512K on an XT (less if an XMS, or extended memory specification, driver makes upper memory blocks or high memory available) and can execute from the command line, allowing automation via batch files.

The generally well-constructed interface makes nearly all features available

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PQ9-PC

CIRCLE 122 ON READER SERVICE CARD

AccuPage and AnyPage: *Two Technologies for Better OCR*

by Edward Mendelson

Until Hewlett-Packard introduced its AccuPage technology in 1991, if you wanted to perform OCR (optical character recognition) from a page with printed shading—or coffee stains—over part of the text, you were better off entering it by hand. First shipped with the HP ScanJet IIc, AccuPage made it possible to scan on shaded text backgrounds reliably for the first time, and, as a bonus, made it easier for OCR packages to determine the format of a page.

To use AccuPage, you need OCR software that uses a scanner driver with built-in AccuPage code—in other words, drivers written for the HP ScanJet IIc and ScanJet IIp. Until early 1992, as a result of a marketing agreement between HP and Caere Corp., only OmniPage Direct and OmniPage Professional included AccuPage in their ScanJet drivers; but HP has now made the code available to other OCR vendors, and you can expect to see it in ScanJet drivers from TypeReader and WordScan Plus by the time you read this. Other vendors will undoubtedly follow suit.

AccuPage consists of two sets of algorithms. One set performs the coffee-stain correction function—more commonly called *auto-intensity* or *dynamic thresholding*. This set of algorithms checks for changes in contrast between dark and light regions of the page as you scan. If it finds a region that has a shaded background, it automatically alters the threshold at which the software decides a scanned pixel should be turned on because it is part of the text. HP wouldn't specify the minimum size of a shaded region, but it is evidently smaller than a square millimeter.

The second set of algorithms helps the software recognize page composition, especially in columns and tables. These algorithms are effective enough for OmniPage Professional to bar the user from specifying the number of columns on the scanned page when using a driver with AccuPage—even though the user can enter the number of columns when using other drivers. OCR software that supports AccuPage uses this set of algorithms in addition to its own page-decomposition algorithms.

SEEING IS BELIEVING

On PC Magazine Labs' tests, AccuPage's auto-intensity feature worked spectacularly well. Software and drivers without AccuPage could find no text at all on one heavily shaded test page, except after tedious trial-and-error manual adjustments to the software's brightness level. But OmniPage Professional's ScanJet IIc driver and the beta version of the comparable WordScan driver read the text with high accuracy. AccuPage also helped these packages read the text at the shaded edge of newspaper clippings.

AccuPage will help HP dominate the OCR scanner market in the same way the company dominates the market for laser printers.

Auto-intensity, unfortunately, slows scanning significantly and adds no noticeable benefits on clean pages. But you can toggle this feature on or off from your OCR software's main menu. On one test, OmniPage Professional needed 21 seconds to scan a typical text page with auto-intensity turned on but only 13 seconds without it.

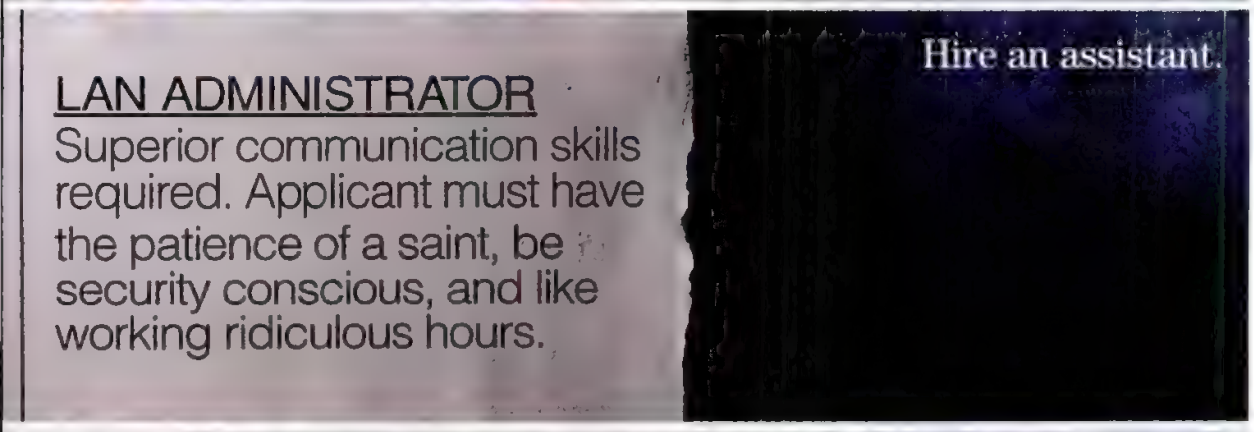
There's no way to turn off AccuPage's page-composition algorithms, and the presence of numerous extraneous factors such as scan variability made it impossible for PC Labs to test its performance reliably.

You can get some AccuPage benefits without an HP scanner through Caere's AnyPage technology. AnyPage works much like the auto-intensity feature of AccuPage but does not include the page-composition feature. The algorithms have a similar effect, but the code itself is different from HP's proprietary code. Caere now offers AnyPage only in its OmniPage Professional driver for the Microtek 600 scanner series. Other scanners may be supported later.

AnyPage worked almost as well as AccuPage in reading shaded text on PC Labs' tests, although the Microtek 600Z with AnyPage scanned much slower than the ScanJet IIc with AccuPage. (Our testing for the story "True-Color Performance at Gray-Scale Prices" in the April 14, 1992, issue of *PC Magazine* revealed that the Microtek is a slower scanner in general, however.) PC Labs found one anomaly: With AnyPage switched on, OmniPage Professional sometimes mistakenly placed the headline on a three-column newspaper story over the text of the middle column instead of at the start of the story. It didn't make this mistake with AnyPage switched off. Caere had never heard of this effect and had no explanation for it.

HP has not applied for a patent for AccuPage, and presumably other vendors can duplicate it someday—although their scanners will also need to duplicate the HP scanners' ability to move backward in order to rescan an earlier part of the page after AccuPage detects a change in shading. Meanwhile, no scanner vendor has announced plans to duplicate the technology, and for the foreseeable future, AccuPage will help Hewlett-Packard dominate the OCR scanner market in the same way the company dominates the market for laser printers. □

Three things you can do to reduce your PC administration time.



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through pull-down menus, shortcut keys, or convenient toolbar buttons. Scanning a page or loading a bitmapped file without activating recognition makes the image appear in two separate views. A pop-up overview displays the entire page, allowing you to outline a margin and also define up to 64 overlapping regions. One unique feature is the ability to toggle between reading inside or outside the recognition regions via a handy button. The layout window—a second input display—offers three magnification steps and an excellent pixel-level viewer that enlarges areas of the document as you drag it over them. Moving a transparent blue rectangle within the overview determines the region that appears in the layout. Operations performed in one window reflect in the other, and most tools (except the magnifiers) work in both windows.

SUITABILITY TO TASK

Recognita Plus

	POOR	FAIR	GOOD	EXCELLENT
Occasional OCR	●	●	○	○
Frequent OCR	●	●	○	○
Complex page layouts	●	●	○	○
Poor-quality documents	●	●	○	○
Foreign languages	●	●	●	○

During recognition, the characters appear line by line in a text box as they are recognized. The software provides an abundant array of output formats but requires you to make your single selection before it reads. Change your mind afterward and you will wait through another recognition pass—only a drawback if you process long files requiring storage in several formats, but one the vendor needs to address.

MOVING RIGHT ALONG

On PC Magazine Labs' tests, Recognita Plus moved at a good pace, even through the rough terrain of dark photocopies, small type, and nasty multicolumn layouts. The product was at least reasonably accurate if not better on all documents except 9-pin, draft dot matrix copy, and similar input (low-resolution faxes, for example), for which it provides no support. We did obtain good results, though, on near-letter-quality print, and Recognita Plus shows a talent for whipping mildly degraded copy into shape.

Its elegant interface, speed, and accuracy raise your expectations but end up emphasizing the software's most frustrating trait—lack of follow-through. The package does a yeoman's job of automatic page decomposition, for instance, but gives you no way to renumber zones. You can also designate regions manually—but you can't specify a processing order.

Despite the vast array of output choices, none produces tab- or comma-delimited ASCII, an unfathomable oversight for such common data formats. Predetermined groupings of ASCII output options offer convenience but allow no customization, occasionally leaving you without the combination you need. In fact, you can fine-tune no output choices, making it impossible, for example, to prevent hard returns at line endings when you save to a word processor format.

Recognita Plus incorporates the basics of first-class learning capabilities, analyzing and recording features of questionable characters rather than merely memorizing their bitmaps. You store the information to a database called a user tree, either creating a new file or appending to an existing one. Loading the same tree when processing similar documents assists recognition.

Here, too, the familiar frustrating theme plays. When invoked, the learning mode starts recognition, stopping at suspect characters. You won't find a way, however, to show the program anything it misinterprets. Hunting for a post-recognition teaching facility bags the same catch—nothing. The program also lacks any tool for showing it how to cut touching characters or put together symbols it incorrectly splits (often the case with double quotes).

Recognita Plus manages to follow through in some areas, though. Screen updates occur briskly, by and large. An excellent test-scan feature makes short work of evaluating images and setting scanner parameters. The File Save pop-up menu contains an append check box that, when deselected, prevents the usual concatenation of results from the current text back to your last file close—an annoying habit other programs seem to pursue belligerently.

Copies shipped as of April 7, 1992, will run under Windows 3.1. Users who bought software before then can obtain a patch without charge by calling the toll-free support line during its normal hours. The company offers a 30-day guarantee, free technical assistance for the first year, and extended support for 15 percent of the list price per year, which includes all upgrades during the covered period.

Recognita Plus, Version 1.2, bears watching. It provides an easy-to-use interface and reasonable OCR capabilities, even on low-end machines. The price could stand a shave, and many of its capabilities lack full implementation, but a strong foundation gives it excellent potential.

FACT FILE

Recognita Plus, Version 1.2

Recognita Corp. of America, 1156 Astor Ave., Suite F, Sunnyvale, CA 94086; 408-241-5772; fax 408-241-6009

List Price: Americas version, $595; English-only version, $495, international version, $795
Requires: 286-based PC or better, 640K RAM, 3MB hard disk space, DOS 3.0 or later, Microsoft Windows 3.0 or later, mouse recommended
In Short: Recognita Plus, Version 1.2, makes a strong initial impression with its good speed, reasonable accuracy, and first-rate interface. This lean package even delivers OCR to low-end hardware, but frustratingly, it often fails to enable fully capabilities lying just under its surface. The price seems a bit high for the functionality it returns, but a solid foundation gives it excellent potential.

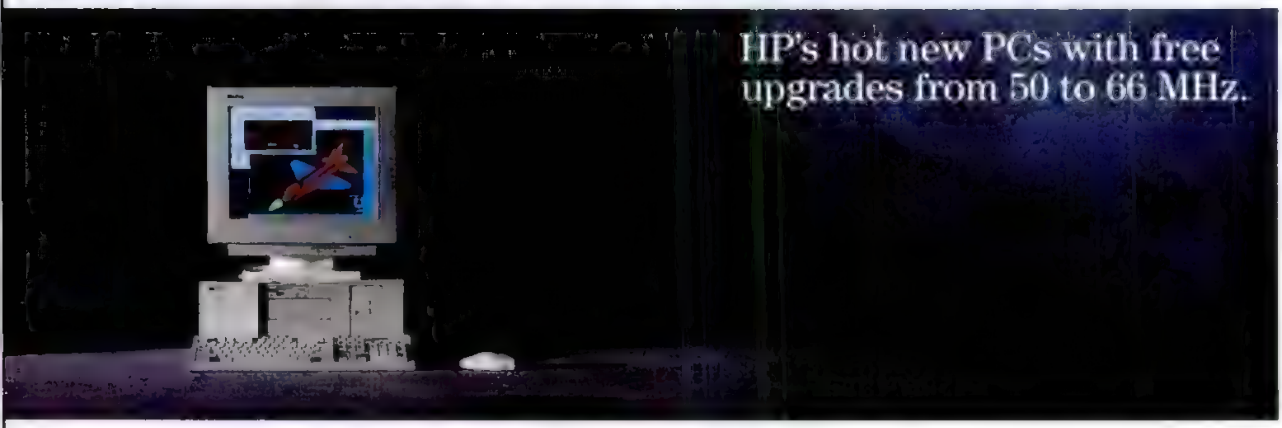
459 ON READER SERVICE CARD

TypeReader

BY MITT JONES

ExperVision has given its better-known OCR rivals a capable young upstart to keep their eyes on. Though suffering from its own collection of unbecoming weaknesses, Version 1.0 of the company's $895 TypeReader offers several alluring features, including an elegantly designed user interface, unmatched flexibility in job processing capabilities, and the ability to retain document characteristics such as margins, type style, and type size. It also matches or outperforms even the best of its competition when it comes to character accuracy, thanks largely to its deft han-

Three things that please both you and your PC users.



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dling of small fonts, draft-quality dot matrix print, and other difficult samples.

The TypeReader interface has advantages over those of most of its competition: All but a few of its features can be accessed via well-arranged push buttons and icons on the main screen, and ExperVision has built the program around a structure that allows nearly unlimited flexibility in the entire recognition process. If you wish to respecify the text regions after region definition or even text recognition, for instance, you may do so without starting again from a new scan. TypeReader maintains the image file, even after the text recognition process, until you've closed the current document.

ExperVision has also built a good bit of flexibility and intelligence into the handling of multipage documents and deferred processing. Unlike WordScan and OmniPage, TypeReader allows you to save a job for deferred processing at any step along the way. Better still, the package is smart enough to pick up where you left off, automatically finishing the steps required for each page.

SUITABILITY TO TASK

TypeReader

	POOR	FAIR	GOOD	EXCELLENT
Occasional OCR	●	●	●	○
Frequent OCR	●	●	●	●
Complex page layouts	●	●	●	○
Poor-quality documents	●	●	●	○
Foreign languages	N/A			

TypeReader earns equally high marks for its skill in automatic page decomposition, where it matches or tops the best of its competition on decolumnization. The package also excelled on tables, showing some fluctuation in its ability to delimit columnar data with tabs but achieving good to excellent results on every trial.

As with OmniPage Direct, TypeReader retains an impressive amount of the original document's characteristics, including margins and an approximation of the original type style and size, when the recognized document is saved to a word processor or spreadsheet format. Even on a résumé that made heavy use of indentation, the program managed to reproduce page formatting, character enhancements, and fonts with impressive accuracy in both Word for

▶ PERFORMANCE TESTS

How We Tested

We put these packages through their paces by running them through several different sets of tests designed to measure their performance on specific types of recognition problems. Space precludes us from publishing all the results as well as the analysis; instead, we have printed some summary data as well as a more detailed description of what we found.

PRESCANNED PAGES

In order to measure the software's best possible performance, we created high-quality 300-dot-per-inch TIFF files from a variety of typeset, laser-printed, dot matrix, and fax-printed pages using an HP ScanJet IIc and its accompanying DeskScan II software. By working from these TIFF files, we minimized the variability and the speed overhead incurred by the scanner and driver.

On most of these pages, all the packages were quite accurate—more than 99.5 percent. At only 300 dpi, 6-point type can be tricky. It proved especially difficult for OmniPage Professional and Perceive in both Helvetica and Times; WordScan Plus had problems with 6-point Times. And all of the packages except OmniPage Professional struggled with the HP LaserJet Line Printer font. Ironically, on the tasks that OmniPage Professional could not handle with high accuracy, it still had higher throughput than the others.

Finally, ReadRight for Windows could not decompose the moderately complex page: a two-column page with a straddle head (a line extending across the top of both columns) with a center graphic.

REVIEWER-SCANNED PAGES

To see if the product's interaction with the scanner imposed any sort of speed or accuracy overhead on the recognition, we tested the packages with some of the pages used for the prescanned pages testing. While the accuracy results were comparable, throughput ranged from the same to four times as high compared with working from the prescanned pages.

DEGRADED DOCUMENTS

We created a set of pages consisting of 24- and 9-pin dot matrix printer output, photocopies at various exposures, and fax output to evaluate the packages' ability to handle poor originals. The products all performed acceptably on the near-letter-quality dot matrix print and on the 9-pin dot matrix output in portrait mode, but none of the packages could creditably handle a landscape version of the same page. (Recognita Plus and ReadRight for Windows are not designed to recognize 9-pin dot matrix output, according to their vendors.)

None of the products could handle the very dark photocopies satisfactorily (OmniPage Professional was the best, with about 73 percent accuracy). Otherwise, no products had problems with the photocopy tests.

WordScan Plus was the only package with over 95 percent accuracy on fax output. TypeReader came in at about 93 percent.

AUTOMATIC DECOMPOSITION

To test the products' capabilities, we tried a variety of complex magazine and journal pages, newspaper clippings, long documents, and tables. Tables especially can confuse OCR packages, the best of which accurately recognize the table contents but occasionally make mistakes when deciding which column should contain a given entry. While none of the packages successfully tackled all the pages, OmniPage Professional, TypeReader, and WordScan Plus showed the greatest flexibility in handling these layouts, attaining better than 95 percent accuracy in most cases. Recognita Plus also performed well. □

Isn't Capitalism Cool?

Where else but in the land of the free and the home of high technology could you find the leader in OCR also offering the lowest prices? Where else could you, the customer, come up such a clear winner? ▲ Look no further than WordScan™ and WordScan Plus, now at their newly reduced suggested retail prices ($295 and $695 respectively). Costing $300 to $400 less than the competition, both offer the industry's most accurate OCR (per a university study), exceptional features and ease-of-use. Providing a better way to get information in any form — *electronic images, faxes or paper* — into your favorite computer applications. ▲ In fact, the last time OCR was reviewed, *PC Magazine, PC Week, InfoWorld* and *Byte* made comments like *"sets a new standard"* (ditto for our 1991 MacUser Eddy Award on the Macintosh side). ▲ The conclusion: WordScan Plus clearly tops OmniPage® Professional with Style Sheets and Templates. As well as superior one-step processing to avoid multiple settings. Both WordScan products provide omnifont technology to handle virtually any business font or type (**bold**, *italic*, <u>underlining</u>). Along with Deferred Processing to optimize computer time. And they fully support HP AccuPage technology for the ScanJet II Series. ▲ So why is so much now available for so little? We can only reply that in these days of Wal-Mart and Price Club, cost is no measure of quality. Indeed, if these reductions lead to the best in OCR becoming truly affordable for any computer user, then both the mandates of the marketplace and the dictates of capitalism will be satisfied. And to that we can only add hooray for the red, white and blue!

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CIRCLE 053 ON READER SERVICE CARD

Performance Tests: OCR Software

For every task except handling degraded documents, OmniPage Professional clearly outperformed the rest of the pack in both speed and accuracy; it is the only package that runs in 32-bit mode, which gave it an edge on throughput. Although TypeReader and WordScan Plus were on the slow side, they had an acceptable level of accuracy across the broadest range of document types, and they proved the most robust for handling dot matrix and fax output.

Test setup

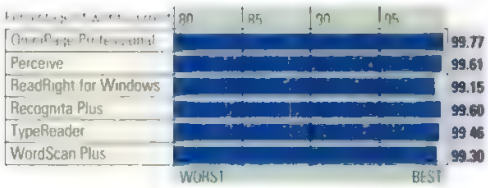
We loaded each package on a Compaq Deskpro 386N (using the 25-MHz 386 processor card) equipped with 8MB of RAM, a 300MB hard disk, DOS 5.0, and Microsoft Windows 3.0. To configure each package for optimal performance, we allowed the vendors to specify how the memory should be allocated and whether the PC should run in Standard or 386 Enhanced mode. We allocated 2MB to SMARTDRV (with a 1MB minimum cache size) and ran the tests in Enhanced mode with a 4MB permanent swap file (with the exception of WordScan Plus, which we ran in Standard mode). We tested OmniPage Professional with AccuPage enabled, which gives it an edge on some of the decomposition tests (but not on those reported here). See "How We Tested" for a more detailed description of the test pages.

For each test, we report each package's median score (the midpoint on a list of raw scores in numerical order). This is not equal to the average, although on most of our tests the two were fairly close. We chose this approach because we recognized that straight averages could be misleading, skewed by the most difficult pages in each group of documents.

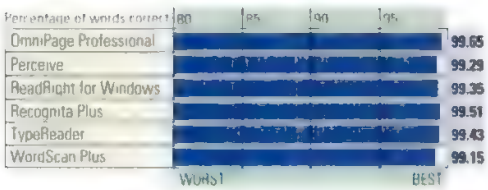
ACCURACY

For the **Accuracy** tests, we compute the percentage of correctly recognized words from each test page and report the median for each group. A score of 95 percent is barely passable (roughly one mistake every second line), over 98 percent is satisfactory (one or two mistakes per 100-word paragraph), and over 99.5 percent is good.

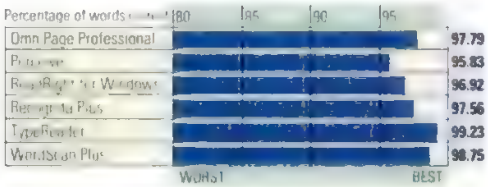
Prescanned Pages



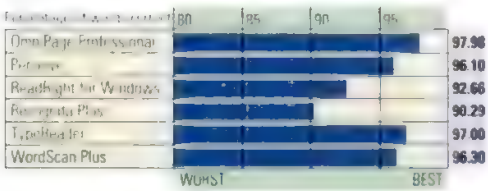
Reviewer-Scanned Pages



Degraded Documents



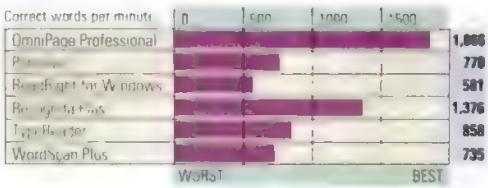
Automatic Decomposition



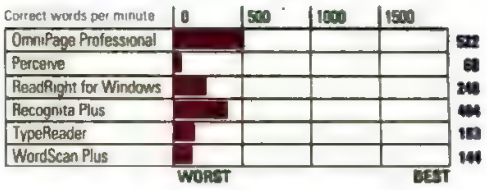
THROUGHPUT

We calculate the **Throughput** test scores by using the underlying raw accuracy results and their corresponding recognition times for each document. We report the median throughput for the suite of tests. Because this score is a function of both speed and accuracy, a relatively inaccurate but fast package may still have a high throughput rate.

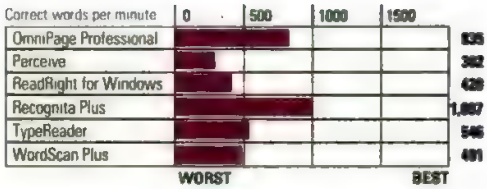
Prescanned Pages



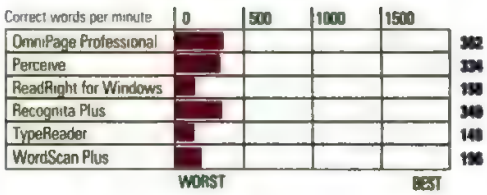
Reviewer-Scanned Pages



Degraded Documents



Automatic Decomposition



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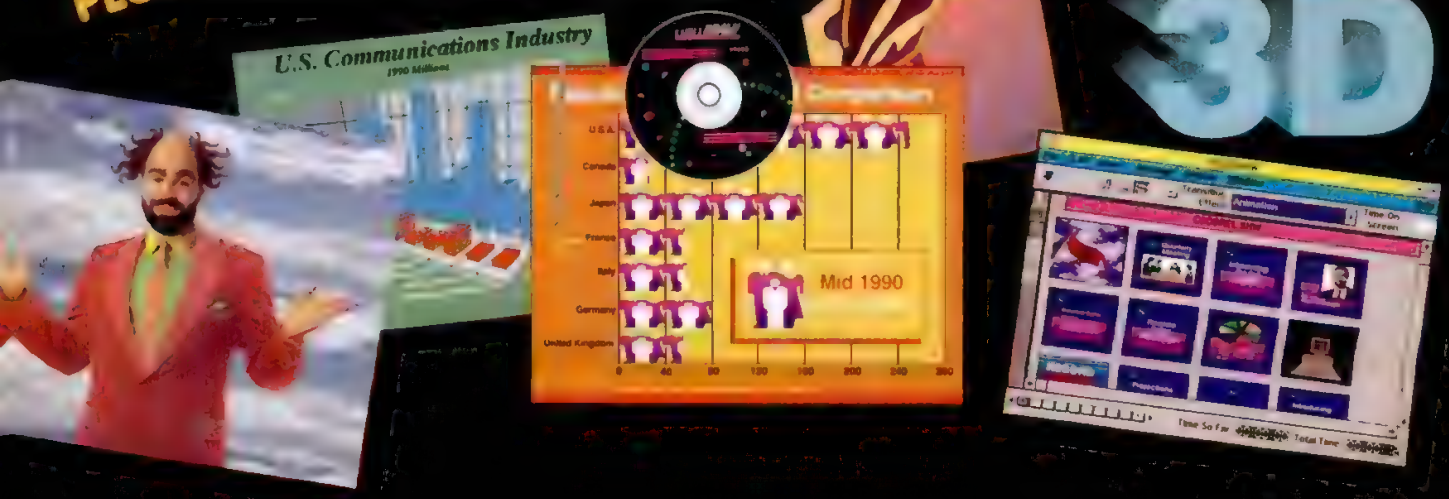

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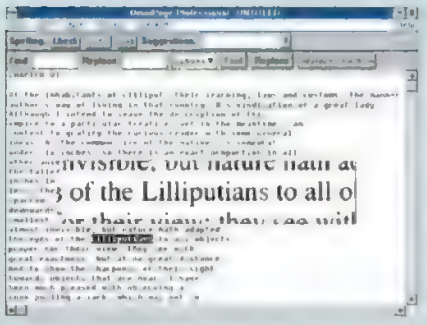
CIRCLE 179 ON READER SERVICE CARD

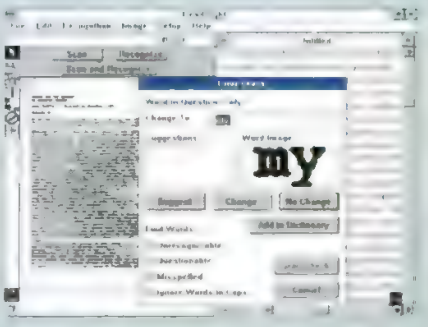
Interfacing with the Recognizers

The real power of OCR software lies in the recognition engine, but the interfaces are more than just hood ornaments. They determine the ease with which you can perform batch processing, reorder the recognition sequence, and proof your text.

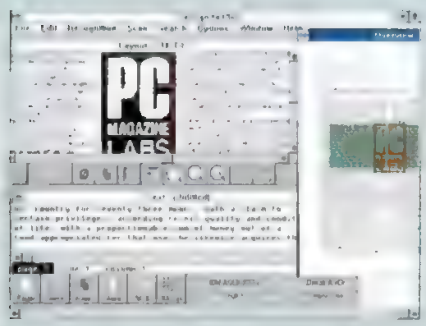


In the editing window of OmniPage Professional, you can click on any text to pop up a large enough section of the scanned image to help you correct errors. The built-in spell-checker optionally looks for words not included in the program's dictionary. It's powerful but awkward to use. There are no keyboard shortcuts; you have to click on the Start button to restart the spell-checker after you make a correction.

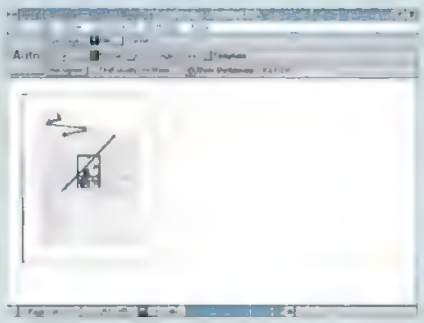
To change the recognition order of OCR zones in Perceive, you double-click within the zone you want to change, then enter its new order number in a pop-up dialog box. The zones will be automatically renumbered to reflect the change. If you want to clear all the zones you designated (or those specified by the Auto Zone feature), you simply hold down the Shift key and click anywhere outside the recognition zones.



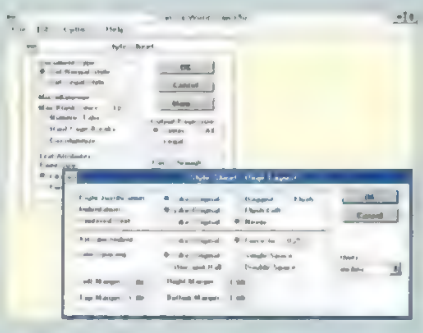
The error-checking module in ReadRight for Windows lets you search for and jump to unrecognized, questionable, or misspelled words. The Image Window on the left holds the current bitmap, while recognized text appears in the Document Window on the right. You can add any misspelled or unrecognized words to the single user dictionary, but the program will continue to flag them anyway.



Recognita Plus displays the entire bitmap in an overview window on the right side of the screen, while the area under the blue rectangle appears again—magnified—in the layout window to the left. Moving this blue rectangle determines which region appears in the layout. The layout window offers three magnification levels and a pixel-level viewer that enlarges areas of the document as you drag it over them. Operations performed in one area reflect in the other.



TypeReader makes the majority of its commands available through either its Gallery, at the top of the screen, or a few controls at the bottom. You can use the locate command from the Gallery to create or apply a template, or force the text to a single column. With these buttons, you may never need to use any of the pull-down menus.



The WordScan Plus stylesheet feature lets you retain most of the original document's formatting or set your own default formatting, including such fine-tuned features as first-line indents, font sizes, and justification. These formats are then automatically applied to the output files created in various word processor formats. By default, the program outputs text in the same format it finds on the page, including justification and point size. You may have to experiment with these stylesheets to get the results you're after.

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6223 ☐Gallery Effects for Windows ... 139.

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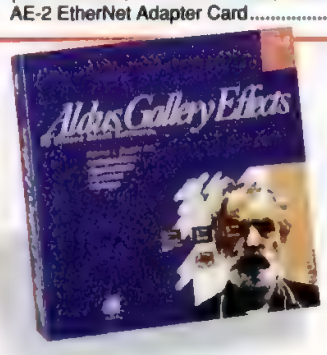
2452 AE-2 EtherNet Adapter Card ... 199.



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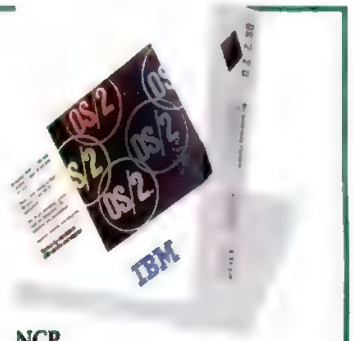

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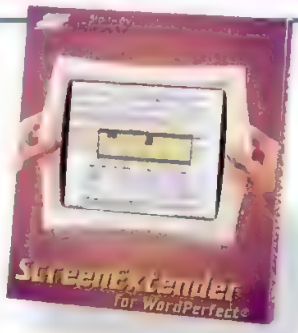

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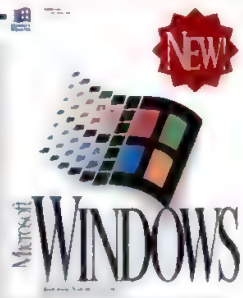

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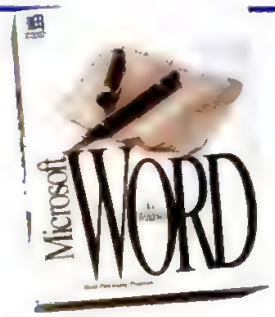

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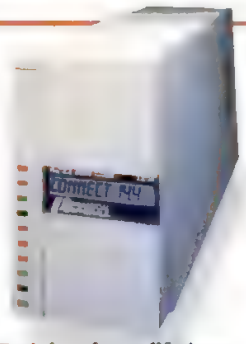

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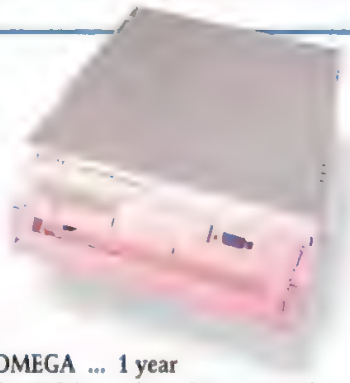

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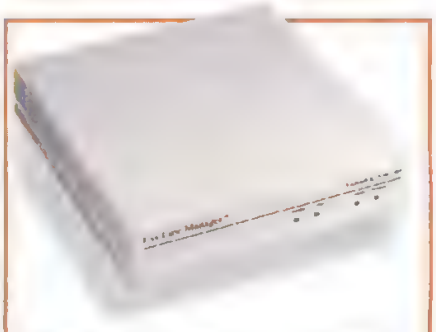

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FACT FILE

TypeReader, Version 1.0

ExperVision Inc., 3590 N. First St., San Jose, CA 95134; 800-732-3897, 408-428-9444; fax 408-456-0823

List Price: $895
Requires: 4MB RAM, 7.5MB hard disk space (8.5 maximum), Windows compatible display, DOS 3.2 or later, Microsoft Windows 3.0 or later, Windows-compatible pointing device
In Short: Though TypeReader, Version 1.0, is not without flaws, this capable first offering does a competent job with a wide range of materials, retains document characteristics such as margins and fonts, and offers document handling and processing flexibility unmatched by its peers
CIRCLE 001 ON READER SERVICE CARD

Windows (RTF) and WordPerfect 5.1 formats. TypeReader also managed to retain columns with our simplest samples, but only when saving to RTF format.

MARGIN MANIA

While this ability to retain fonts and page formatting should prove invaluable in some applications, it brings a collection of serious drawbacks along with it. For instance, the program inserts codes for margin settings at the beginning of nearly every paragraph; at least, this is true for WordPerfect files and possibly for other formats as well. For RTF format, this makes sense; in a WordPerfect document, it only proves a nuisance.

A second problem makes the first all the more bothersome: You can't turn off character-format retention. Unless you output to an ASCII file, the program will retain as much of the formatting as it can, whether you like it or not.

Other somewhat related problems require a bit of explanation. Instead of dumping recognized text into an ASCII editor, which would hide the retained page layout and fonts from the user, the package displays it in a form very close to that of the original page, retaining even the precise columnar layout. Unfortunately, this screen image achieves the apparent retention of columns by placing the defined text regions over the bitmap, not by displaying them in the order they will appear when output to a file. To discern the order of the text, you will have to toggle back to the image view or save the file in a non-TypeReader format and call it up elsewhere.

This approach might still seem preferable to the austere editing screens of most other packages were it not for an additional problem: This initial version of the program suffers from severe deficiencies in its handling of screen fonts, with or without the help of Adobe Type Manager, which is included with the package. In any

TypeReader proved admirably versatile during testing, generating acceptable to excellent results on nearly every page.

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"I want vivid color from an affordable printer."
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Tektronix

view smaller than 100 percent, for instance, the program truncates the tops of characters, rendering them unreadable in some cases. In any view, several adjacent words can fail to appear on the screen, an oddity that can make proofing and editing rather challenging.

TypeReader, which is based on ExperVision's proprietary Machine Learned Fragment Analysis (MLFA) algorithms, proved admirably versatile during testing, generating acceptable to excellent results on nearly every page on which we tested it. In comparison with the other packages, it particularly excelled on 6-point typeset text scanned at 300 dots per inch, on draft dot matrix output, on multigeneration photocopies, and on fax output.

ExperVision claims that its MLFA algorithms can recognize thousands of fonts with high accuracy, including stylized fonts. Verifying this claim proved beyond the possible scope of PC Labs' testing, but TypeReader did achieve somewhat impressive results with a laser-printed page of 12-point Zapf Chancery text: The package missed few enough characters to render the finished product useful, and it did manage to recognize roughly 75 percent of the characters correctly.

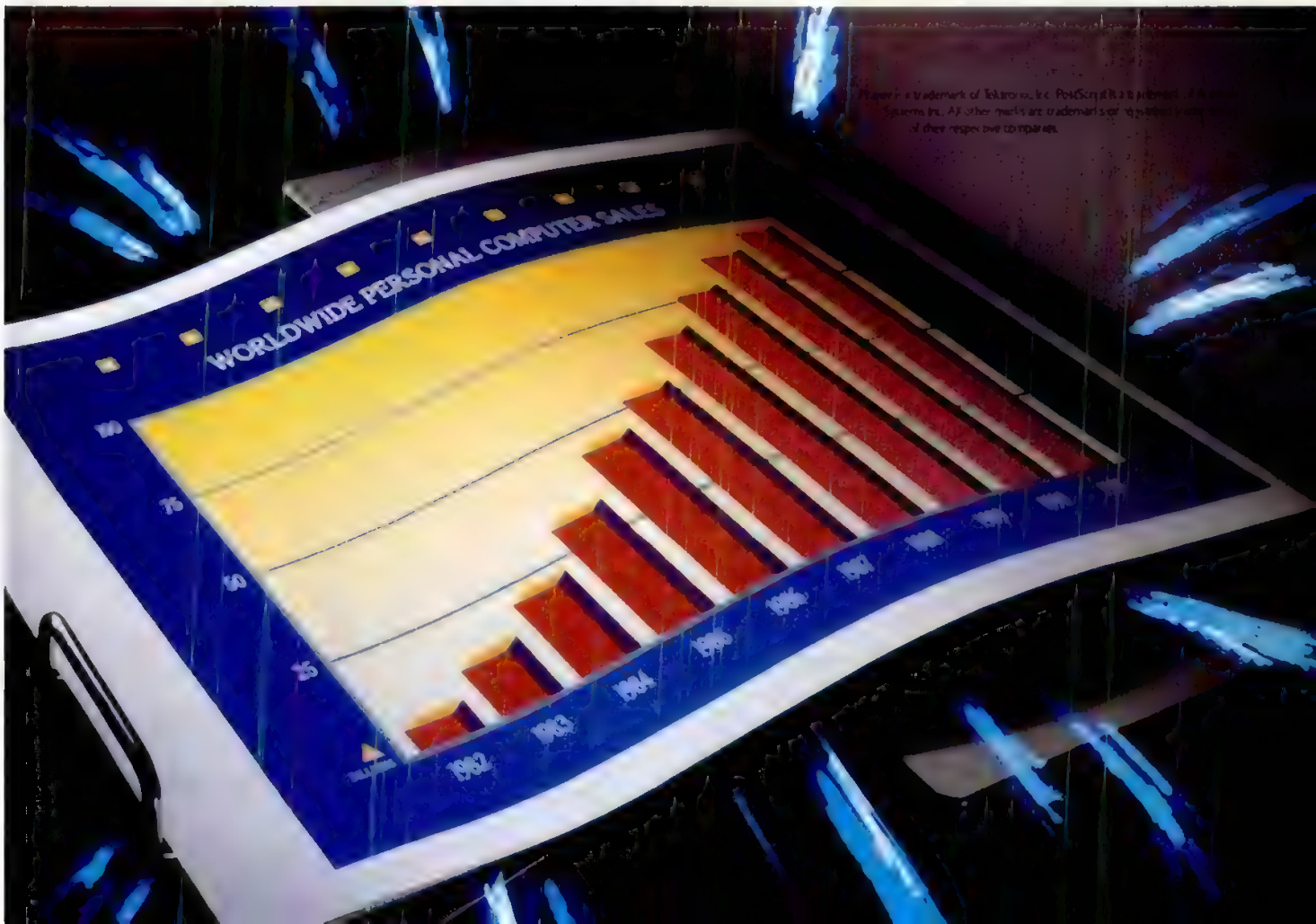
On the downside, TypeReader fell slightly short of OmniPage Professional in accuracy when reading the common sizes of the most common fonts. As with every other package reviewed here, it also suffered from a blind spot or two, the most serious being its difficulty with the native fonts of the HP LaserJet Series II. On five tries at our 12-point LaserJet Courier sample, for instance, it produced from 2 to 15 word errors, averaging about 10.

Version 1.01 of TypeReader promises to add support for scanning up to the scanner's limit and to smooth over some of 1.0's rough edges.

When it comes to recognition speed, TypeReader keeps up with or surpasses most of its competition, lagging behind only OmniPage Professional, the clear leader in throughput speed testing.

The package turned in less than spectacular results during the document proofing portions of our tests, but our testing procedure, which included spell-checking when applicable, undoubtedly showed TypeReader's proofing tools at their worst: Though equipped with a spell-checker, the package only highlights unmatched words; it doesn't provide any way to jump from one to the next. When used without spell-checking, TypeReader's proofing capabilities rank among the fastest. The program allows you to jump to the next suspect or unrecognized character merely by hitting Tab, a quick method of proofing that every OCR package should provide.

Additional strengths include the package's support of scan templates and its ability to create different output files



within one job by using a blank page as a job separator. Weaknesses include its inability to perform recognition on PC Labs' test landscape images scanned in another package, its inability to output ASCII files with an additional carriage return between paragraphs, and its lack of support for 400-dpi scanning, though it can perform recognition on 400-dpi TIFF files scanned externally.

Version 1.01 of TypeReader, which ExperVision plans to ship by the time this issue is in print, promises to add support for scanning resolutions up to the scanner's limit (though ExperVision has only tested up to 600 dpi) and to smooth over some of the rough edges of the first version, including its problems with screen fonts and its inability to insert extra carriage returns at the ends of paragraphs. Version 1.01 will also reportedly add an AccuPage-capable driver for HP scanners and provide full compatibility with Windows 3.1 (which requires solving a few additional screen-handling problems).

Though failing to match the perfect to near-perfect accuracy of some packages on the most common fonts, TypeReader, Version 1.0, offers capabilities across a range of fonts and materials that none of its competition can thus far match, making it a top choice for nearly any application. Its flexibility in job processing should also prove an important advantage in many applications. Assuming ExperVision follows through with the planned fixes and improvements in Version 1.01, you will have few reasons to look elsewhere unless you absolutely demand the highest speed or just can't live with the negative side of TypeReader's extensive format retention.

Editor's note: At press time, ExperVision dropped the price of TypeReader to $695.

WordScan
WordScan Plus

BY EDWARD MENDELSON

WordScan Plus, Version 1.1, is not the speediest OCR program you can buy, but it can often be the one that gets the job done with the least pain. Calera Recognition Systems' $695 package sets high standards of accuracy over a broad range of difficult document types, including dot matrix and fax pages. It lets you perform basic OCR tasks from a simple icon-based menu. Its verification screen displays pop-up images of characters the program was uncertain it recognized correctly. And its template feature can automate repetitive chores, such as removing the header from every page of a 100-page report.

If you don't need the refinements in WordScan Plus, Version 1.1, a $295 version called WordScan offers the same rec-

SUITABILITY TO TASK

WordScan Plus

	POOR	FAIR	GOOD	EXCELLENT
Occasional OCR	●	●	●	○
Frequent OCR	●	●	●	●
Complex page layouts	●	●	○	○
Poor-quality documents	●	●	●	○
Foreign languages	●	○	○	○

ognition engine clothed in a reduced feature set. WordScan won't display pop-up images of doubtful characters, it won't let you define more than one zone of text or graphics, and it doesn't give you the larger program's options for formatting output. (An upgrade from WordScan to WordScan Plus costs $195.)

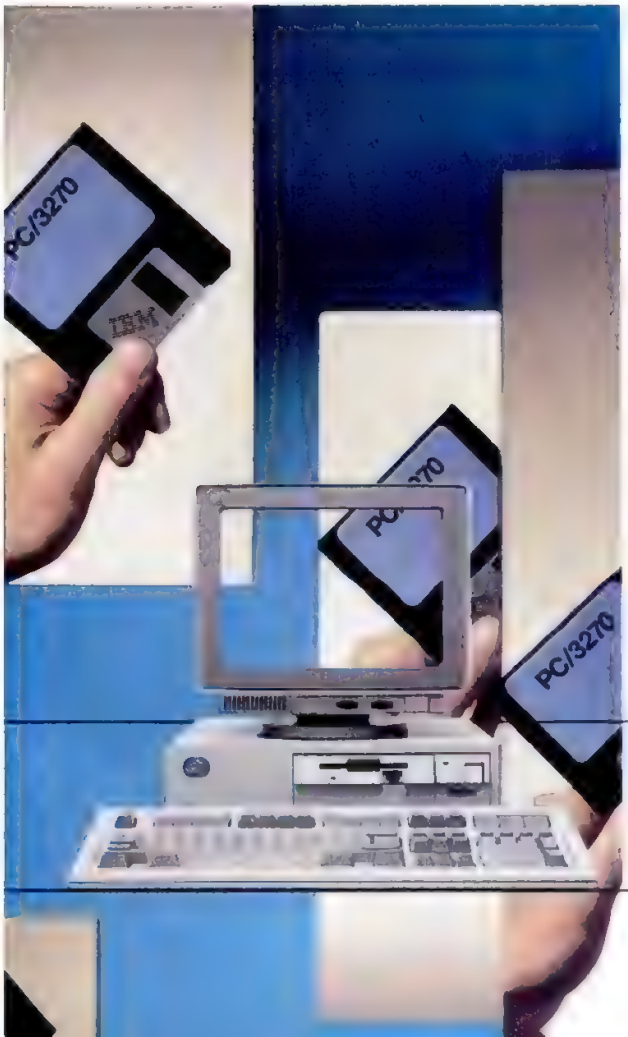
If you use a fax board, Calera's $149 FaxGrabber does its heroic best to translate incoming faxes to editable text—an effort often defeated by the rough-edged quality of most fax output. FaxGrabber lurks in the background while you run Windows, and it either automatically processes incoming faxes or checks periodically for their arrival. It does not have an interface of its own except for a set of icons that represent the Windows applications you choose for optionally previewing incoming faxes and for editing the processed text. For example, you could choose Windows' Paintbrush for preview and Word for Windows for editing. FaxGrabber uses the Windows Clipboard for moving images and text from one application to another.

All three of these programs run under Windows, although you install WordScan Plus and WordScan from the DOS command line. When you open WordScan Plus, you're presented with a simple menu with icons that let you choose whether to scan for text, images, or both. Other icons let you choose between landscape and portrait pages (FaxGrabber recognizes the page orientation automatically, but WordScan Plus can't) and between normal and dot matrix type. This latter option is slightly misleading; you use the normal option for proportional text, even if it was printed by a dot matrix printer, and you use the dot matrix option for monospaced text, even if the text is typeset. You can use blank sheets to divide a stack of pages into separate output files.

WordScan Plus's template and other options can be saved in a settings file for easy customization of tasks you perform often.

After a page or stack of pages is scanned, a preview screen lets you use the mouse to define alphanumeric, numeric, or graphical zones; you can define different zones for each page or use one zone definition for all pages in a stack. You can save a zone map as a named template and use it automatically for later scans. The template and other options can be saved in a settings file for easy customization of tasks you perform often.

When you get below the main menu and preview screens, WordScan Plus becomes a bit more confusing. If you scan a stack of pages but want to defer recognition or interrupt processing, you have to use the Save menu first. After you do so, the program displays a long, baffling message explaining that it didn't save in the format you specified, and lists the three unintuitive steps required to finish the job



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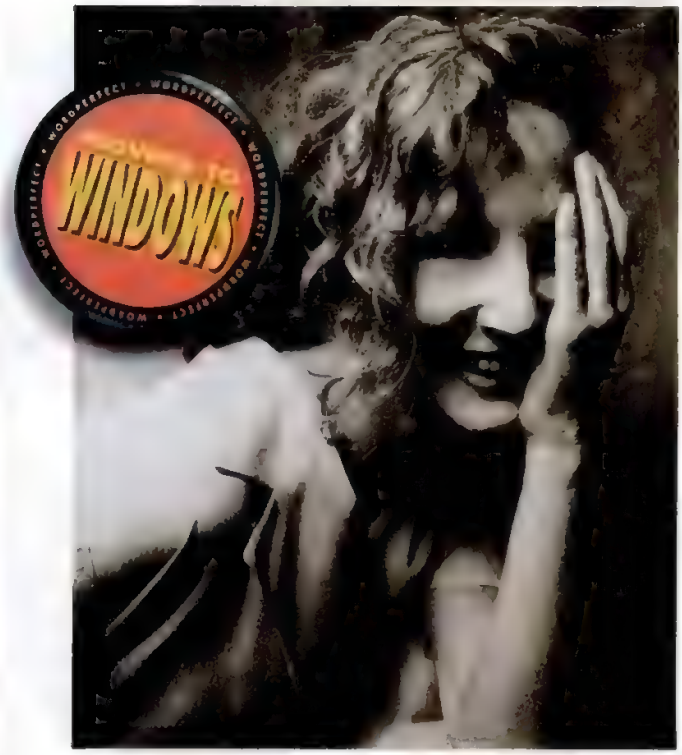

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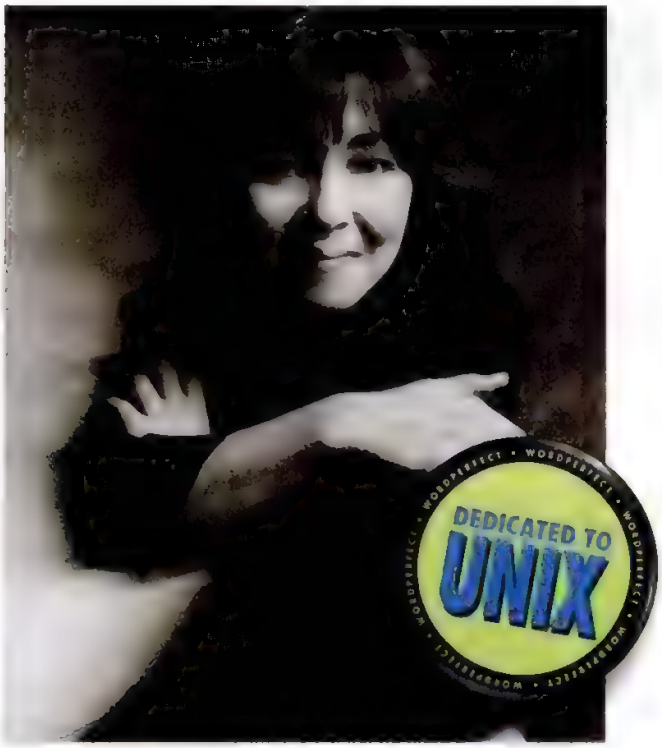

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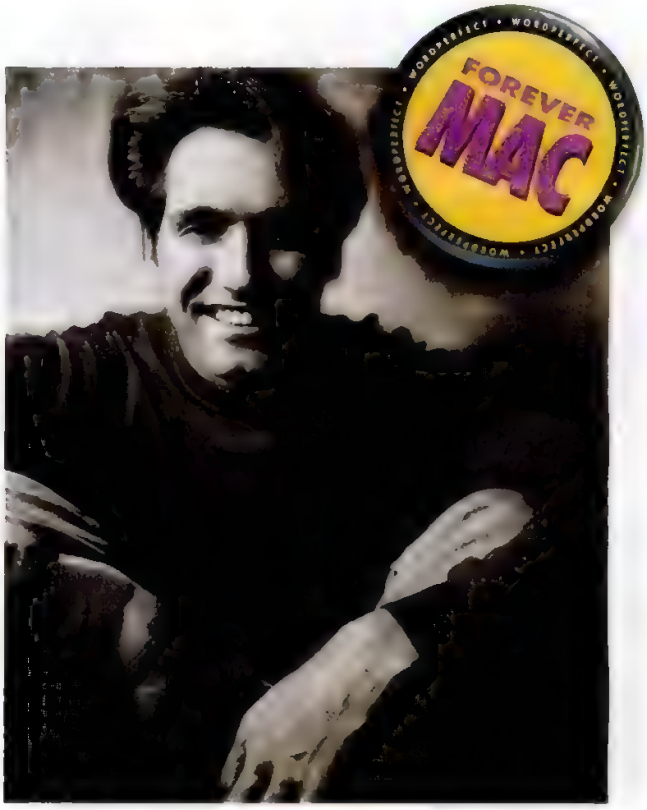

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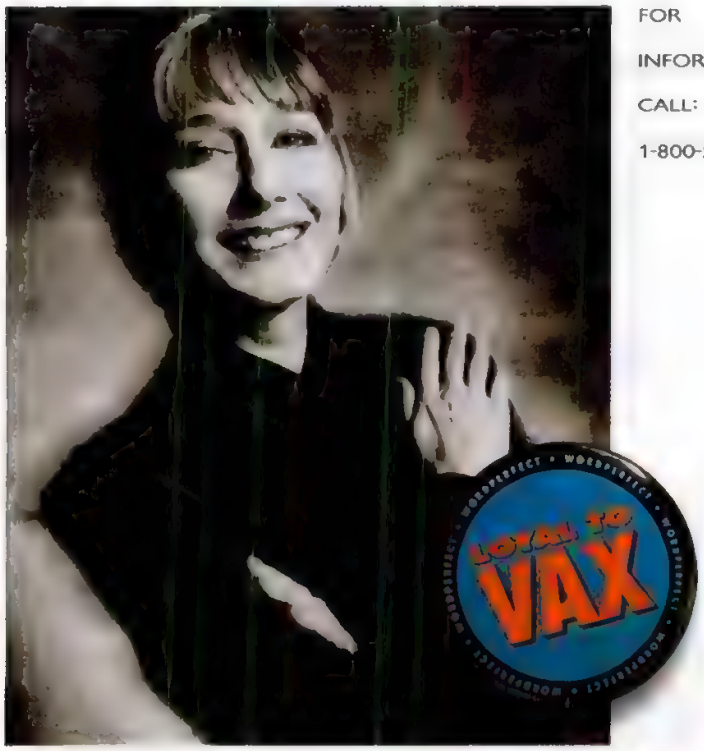

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later. You will probably forget them, but the manual reproduces the message.

You'll find the proofing tools in WordScan Plus to be a mixture of convenience and annoyance. Before you edit the scanned text, the program flags words not found in its built-in dictionary or in a specified user dictionary. It also flags any characters that it isn't certain it recognized correctly. To edit the text, you open the program's "pop-up verifier," an editing screen in which flagged characters and words are highlighted.

Press Ctrl-L to reach the first flag and a small image of the doubtful area pops up. When you reach a doubtful word, the image of the whole word appears and you can accept or edit it easily. You can add a doubtful word to the user dictionary, and it won't be flagged again later in the file. Annoyingly, the image of a doubtful character sometimes shows only a fragment of a letter, with the rest of the letter grayed out, because the program misinterpreted a single letter as two letters and thought it could recognize one. You may end up having to refer to the paper text original to figure out what was there.

Another annoyance is the verifier's insistence on telling you at the end of every page that it found no more flags. It doesn't tell you if there are any pages left to check. Unless you remember to press Ctrl-N or use the menu to reach the next page (if there is one), you're likely to exit the verifier and lose the chance to do further proofing.

If your document consists largely of proper names, the pop-up verifier may refuse to display the text because there are too many doubtful-word flags. You will have to rescan with the suspect-word flagging option turned off.

The stylesheet feature in WordScan Plus is another mixed blessing. By default, the program outputs text in the same format it finds on the page, including justification and point size. This works reliably for files exported to your word processor, but unless it is set up to use a monospaced font like Courier, you will get lines padded with spaces to produce full justification in ASCII. You'll have to experiment with the stylesheet in order to achieve exactly the results you need.

A "technical assistant" feature checks your system configuration and mistakenly reports errors if your setup includes an advanced memory manager or third-party disk cache instead of the less ca-

FACT FILE

WordScan, Version 1.1

WordScan Plus, Version 1.1

EDITOR'S CHOICE

Calera Recognition Systems, 475 Potrero Ave., Sunnyvale, CA 94086; 800-544-7051, 408-720-8300; fax 408-720-1330

List Price: WordScan, $295, WordScan Plus, $695
Requires: 2MB RAM, 6MB hard disk space, DOS 3.1 or later, Microsoft Windows 3.0 or later.
In Short: WordScan, Version 1.1, is a bargain despite its inability to pop up images in the verifier. High accuracy on even the most difficult document types makes WordScan Plus, Version 1.1, easy to recommend at any price. It's not the speediest program, but WordScan Plus's templates and skill with spreadsheets set it apart from the competition.

461 ON READER SERVICE CARD

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pable files that come with Windows.

Unlike OmniPage, WordScan Plus doesn't let you train it to read math or other symbols or unusually shaped letters in printed texts. You can't customize zone contents to include subsets of the alphabet. Nor can you add dictionaries for scanning foreign languages, although French, German, and trilingual versions are available in Europe. (You can contact Calera about obtaining them here.)

IMPRESSIVE PERFORMER

The recognition engine in WordScan Plus, which uses a mix of Omnifont and other technologies, was among the best tested by PC Magazine Labs, with good to excellent results in all categories of testing. On perfect samples, WordScan Plus did not perform as well as OmniPage Professional, but with degraded copies and dot matrix text, it produced impressive results. Its speed was less impressive, substantially slower than OmniPage Professional in both recognition and throughput. PC Labs was able to test a beta version of the WordScan Plus AccuPage driver, which shipped just after we completed testing. It produced results equivalent to OmniPage Professional's when scanning shaded or stained paper.

WordScan Plus decolumnized effectively, although it sometimes mistakenly inserted spaces instead of tabs between spreadsheet columns. Calera's technical support said that this kind of failure can occur almost randomly. WordScan Plus outputs accurately in all major formats, including spreadsheets, but you have to remember to choose decolumnized ASCII instead of ASCII if you don't want multicolumned output from multicolumn text. You can save graphics in .PCX or TIFF formats, but not automatically.

WordScan Plus's speed doesn't match the best of the competition, but it achieves admirable accuracy, especially with badly reproduced pages.

The Calera package you choose will depend on your needs and budget. FaxGrabber has unique abilities, but it's a complicated solution to a problem that can be solved reasonably well by using an ordinary OCR program to scan faxes on-disk after your fax software alerts you to their arrival. At $295, the plain WordScan package is a bargain, but its inability to display pop-up images in the verifier is an almost guaranteed source of headaches. Calera's richest and most mature package, WordScan Plus, doesn't let you view every part of your original file when proofing, and its speed doesn't match the best of the competition. But it achieves admirable accuracy, especially with badly reproduced pages. And if you need its template and stylesheet features and its ability to export properly formatted spreadsheet files, you may find it the one product on the market that exactly meets your needs. □

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What do you need to use PaperWorks? A 386 PC with 4 MB of memory and a hard disk with 20 MB free. Windows 3.0 or 3.1. One of the fax cards listed below. And something to print your Smart Paper forms on. Even an ordinary dot matrix printer or fax machine will do.

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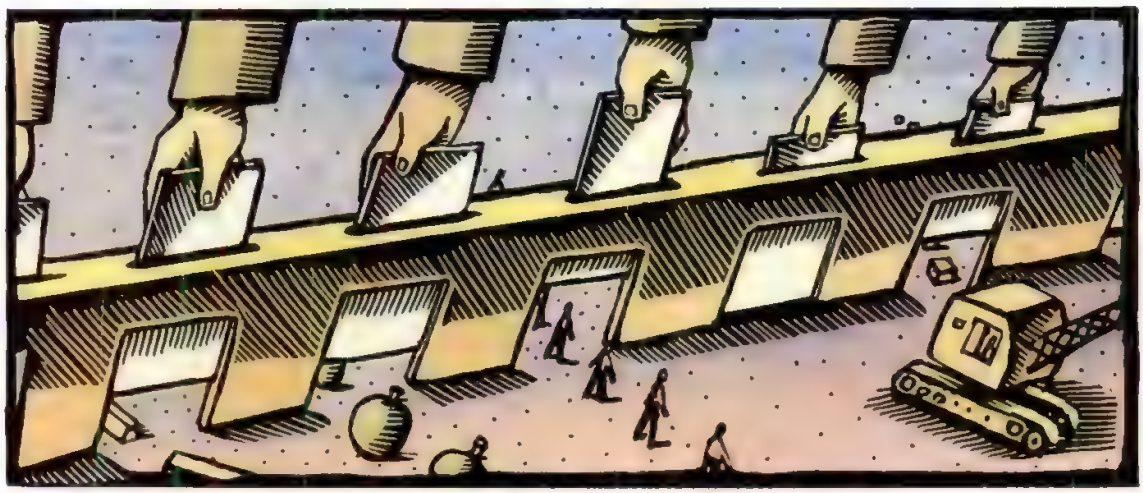

ILLUSTRATION BY RANDY LYNUS

Project Management Software Gets a Grip on Usability

Project management has long been the domain of an elite cadre of experts. The eight packages reviewed here expand the turf with their emphasis on graphical tools and ease of use.

Tiring buzzwords like "ease of use" and "user friendly" have echoed through the software marketplace for what seems like eons. Yet vendors of project management software have been slow to heed the cry. Project management software has the power to track tasks, allocate resources, adjust complex schedules, and spot project bottlenecks before they become problems; this offers potential benefits to multitudes of managers. Until recently, however, the difficulty of learning and using these packages created software that sat gathering dust on the office shelf instead of managing projects in the PC.

IN THIS REVIEW

328 *CA-SuperProject for Windows*
334 *InstaPlan EMS*
340 *Microsoft Project 3.0 for Windows*
344 *Project Director*
346 *Project Scheduler 5*
355 *SureTrak Project Scheduler*
362 *Time Line*
366 *Time Line for Windows*

by Henry Fersko-Weiss

Fortunately for potential users, in the last couple of years, manufacturers of mainstream project management packages—those costing less than $900—have finally begun to get the message. As a result, newly streamlined project management software is now attracting a much wider audience than ever before. Today, general managers, independent contractors, and small-business owners—the people who once avoided project management because it seemed like a Chinese puzzle—are contentedly dragging task bars and boxes around on project Gantt and PERT charts.

The quest for usability began nearly four years ago, when Scitor Corp. introduced Project Scheduler 4, the first graphical project management package. Here was a product that demonstrated the viability of using presentation-quality graphics as project management tools. The product's Gantt chart, with its red and blue outlined bars for critical and noncritical tasks, had a clean, compelling look that communicated information more clearly than competing packages. The PERT chart was better still: You could create tasks by pointing and clicking with the mouse and then use the mouse to establish dependency links between the task boxes. It was a little bit like working with a two-dimensional Erector set.

While Project Scheduler 4 had its flaws (it didn't offer much control over its graphics, and it had a proprietary interface), it clearly demonstrated the advantage of using a graphical interface for project planning tools.

THE WINDOWS CONTINGENT

The debut of Microsoft Windows 3.0 brought the next major advance: Microsoft Project for Windows. This program turned project managers into presentation artists. They could select colors for Gantt bars and PERT boxes, set fill patterns and end symbols for bars or border styles for the boxes, apply color to text, and change the font style and point size. It wasn't just a matter of aesthetics; colors and styles added meaning. If you wanted to show which resources were overallocated or which tasks were running over budget, color and a different typeface communicated this information at a glance.

Project for Windows' rapid success set the stage for most of the development that has occurred over the past two years, as nearly every major vendor began to work on a Windows version. The features race that had characterized earlier development efforts was pushed into the background; the quest for "graphicality" and usability took priority.

The current crop of packages show the results of these efforts. Half the products covered in this review—CA-SuperProject for Windows, Microsoft Project 3.0 for Windows, Time Line for Windows, and Project Director—run under Windows. Counting Project Scheduler 5, with its proprietary interface, five out of eight are fully graphical.

PUSH-BUTTON AUTOMATION

Toolbars are one important advance in ease of use; they provide iconized buttons dedicated to specific tasks. Time Line for Windows, for example, lets you display a planned-versus-actual Gantt chart at the click of a button instead of making the change through a layout or view menu. Because it's so easy to go back and forth, you can work in an uncluttered screen, pop up the combined Gantt, and then quickly go back to the task bars for actuals. Similarly, Microsoft Project lets you click a button on the toolbar to mark a task 100 percent complete, rather than open a task entry form and type "100" in a percent-complete field.

Microsoft Project fully implements task buttons; in addition to providing a broad selection of buttons, MS Project gives you the option of attaching task icons to any command, view, or macro you choose. You can even draw your own icons, using a built-in icon design tool.

PUSHING INTERACTIVITY

Beyond adding task buttons, the graphical packages, including Project Scheduler 5, have become even more interactive in

Suitability to Task: Project Management Software:
Microsoft Project, Time Line, and CA-SuperProject outshine the competition, but Project Scheduler 5 and Time Line for Windows aren't far behind.

SUITABILITY TO TASK

	Product Name			
	POOR	FAIR	GOOD	EXCELLENT
Planning a project	●	○	○	○
Managing a project	●	●	○	○
Communicating about a project	●	●	●	○
Workgroup project management	●	●	●	●

To test each package's ability to plan, manage, communicate, and share information with a group, we used a four-task newsletter project. The tasks were designed to test each of the major functions essential to project management software.

Planning a project measures a package's ability to enter, edit, link, group, and manipulate task data and resource information. It also assesses the ease with which a user can associate tasks and resource data and batch-edit multiple tasks or resources, as well as the packages' granularity of resource assignments, and the level of assistance provided during these processes.

Managing a project looks at the software's ability to modify task names and durations, insert new tasks, and set up actuals. This rating also covers a package's prowess at updating and filtering project information, adjusting resource loads to meet deadlines by automatic resource leveling, and analyzing causes of resource overallocation. Task automation is also covered here.

Communicating about a project evaluates the ease with which these packages customize such on-screen elements as bars and symbols, establish text formats, and create multiple project views. It also addresses the annotation of Gantt chart bars and the modification of PERT charts in both appearance and content. Finally, it evaluates how the packages we review handle the job of printing visual project management aids.

Workgroup project management assesses the package's multiproject capabilities, looking at how easily packages merge projects and create subprojects and multiple dependent and independent projects. Network ability is an issue here, and we looked at how easy it is for users to share data on a network, execute project files from a server, and notify project supervisors of updates.

operation. Time Line for Windows and MS Project, for example, use a mouse-controlled pane divider to enlarge or shrink the spreadsheet area on the Gantt display. This gives you instant control over how much data you see next to the Gantt chart.

Interacting directly with graphical objects makes intuitive sense for project management programs because their main building tools, the Gantt and PERT charts, are graphical in nature. Dragging objects around on-screen has been a part of graphical project managers from the beginning. Project Scheduler 4, for example, let you drag dependency lines between task boxes on the PERT chart, and MS Project 1.0 for Windows let you change the start date or duration of a task by dragging the appropriate Gantt chart bar or pulling its end like a piece of taffy.

More recently, vendors are increasingly using another type of interactivity: double-clicking on hot spots to initiate changes in screen elements, such as the time scale displayed above the Gantt chart in MS Project. In fact, MS Project 3.0 has carried this form of interactivity farther than any of its competitors. In MS Project, you double-click on the line connecting two tasks on the PERT chart and change their relationship in a dialog box; double-click to get a summary task on the Gantt chart and you can collapse or expand it.

INTELLIGENT PROJECT PATROL

Another significant usability enhancement is the addition of artificial intelligence–style features in the packages' help functions. For example, MS Project offers PlanningWizards, which guides you through a variety of work scenarios, from starting up a project to setting preferences for colors, date-and-time formats, and so forth. It's like having a consultant looking over your shoulder, advising you on your next move. Time Line for Windows provides Co-Pilot, the least intrusive of these special help functions. It sits in the background watching your actions, popping up only if you do something ambiguous, like moving a task bar to a position that could indicate either a new dependency relationship or a new starting date.

The use of smaller data-entry boxes that don't totally obscure your view of the

PC MAGAZINE ▶ EDITORS' CHOICE

- **Microsoft Project Version 3.0 for Windows**
- **Time Line, Version 5.0**

Two project management programs stand out above the rest: Microsoft Project Version 3.0 for Windows and Time Line 5.0. MS Project has a wonderfully flexible Windows-based interface, and its project management features are deep and well rounded enough to handle most situations. Time Line has the best all-around set of project management features plus the advanced features you need for the most exacting projects. Its DOS-based interface, while not up to MS Project's standards, is solid and refined.

INTERFACE CHAMP

Microsoft Project 3.0 for Windows' versatile, easy-to-use interface allows you to mix together different views in a split screen or to open multiple project windows. MS Project also lets you liven up your project charts with color, typography, multiple bar symbols, and a wide selection of fill patterns. MS Project's use of dedicated task buttons and hot spots that you can double-click on are the best of any program we reviewed. Also noteworthy is the package's powerful learning aid, PlanningWizards, which steps you through important program operations, such as setting up a new project or resolving resource conflicts.

CA-SuperProject for Windows and Time Line for Windows also boast good interfaces. However, while SuperProject offers even richer project management features than MS Project, it takes far less advantage of Windows' graphical capabilities, and project data is harder to get at in this package. Time Line for Windows offers great control over graphics and its interface is admirably simple, but it doesn't offer the same breadth of project management features as Microsoft Project.

FEATURES LEADER

Time Line 5.0, on the other hand, is loaded to the gunwales with project management features. You can schedule tasks down to the minute, split them, set up complex dependency relationships, schedule them as effort-driven or time-driven, and assign priorities. The current release has also successfully addressed the resource-management weakness found in earlier versions. Now Time Line gives you quite powerful features in this area, including resource calendars, variable resource allocations and costs, and resource contouring. Time Line also does an outstanding job of tracking and reporting project progress.

Because of the depth of its features, Time Line 5.0 is not the easiest program to learn, but once learned, its forms orientation and Lotus 1-2-3–style menus make it easy to use. For a character-based program, the Gantt chart (the main scheduling screen) is quite good.

The only product that comes close to measuring up to Time Line in terms of project management features is CA-SuperProject (either the DOS or Windows version). In fact, SuperProject for Windows did the best job of automatic resource leveling on our test suite. However, as noted above, its interface is awkward enough to make accessing project data more difficult than with Time Line. Project Scheduler 5 is another feature-rich program that offers a graphical interface in the DOS environment. Its screens are better designed than Time Line's, but you can't customize the displays, and the feature set isn't as well rounded. However, Project Scheduler 5 definitely stands out when it comes to working with multiple projects.

underlying screen as you work is another recent innovation. Time Line for Windows does the best job with this, providing small, highly focused information boxes for task description, assignments, and so on. Since you can move these boxes around on-screen, it's easy to tuck one into a corner and move back and forth between it and your Gantt or PERT charts.

The DOS programs, such as SureTrak Project Scheduler and InstaPlan EMS, have also increased usability by improving the look of their charts, adding mouse support (SureTrak), and adding graphical print-preview modes (InstaPlan and SureTrak). (Time Line already had this feature in its Version 4.0.) SureTrak also includes a full-blown graphical report editor that lets you do some very fancy customization. For example, you can add text anywhere on a chart and orient it to any angle by twirling a text box like the hand of a clock.

FEATURES NOT FORGOTTEN

While usability and GUI enhancements dominate present upgrades, some packages have added project management features as well. Most notable among these are the enhancements made to Time Line 5.0, which include such important resource management tools as resource calendars, variable resource allocation, task splitting during resource leveling, and assignment contouring. These features make it possible to precisely model how resources will be applied to tasks. Project schedules can now be adjusted for nonstandard resources that, for example, are available for only certain hours on particular days. Not only do these features result in more accurate schedules, they allow you to manage more complex projects.

Some packages have also added important facilities for managing multiple projects. Project Scheduler 5, in particular, has made strides in this area. It lets you integrate independent projects into a master project plan where you can create dependency links between individual tasks and validate the combined project structure on a master PERT chart. Then you can break the projects apart again so each project manager has his or her own schedule to work with, while keeping the

Project Management Lingo Elucidated

BY HENRY FERSKO-WEISS

ALAP Designates a task that should start as late as possible, using all the free-float time available.

ASAP Used to indicate a task that should start as soon as possible, given the start date of the project and its predecessor tasks.

baseline The original project plan, including time schedule and resource and cost allocations. It is used for comparison against actuals to track and analyze a project's progress.

critical path The sequence of tasks or activities whose schedules and durations directly affect the date of overall project completion.

earned value A performance measure calculated by multiplying a task's planned cost by the percentage of work completed. Earned value calculations are required in all projects for the U.S. government.

float (also called slack) The amount of time a noncritical task can be delayed before it affects another task's schedule.

Gantt chart A graphical representation of a project schedule that shows each task as a bar whose length is proportional to its duration. Many programs include a spreadsheet section to the left of the Gantt chart to display a selection of project data.

Hammock task A task whose duration is calculated based on the time span between its predecessor and successor activities. It is, figuratively, suspended between other tasks.

histogram A bar chart that shows resource workloads by time period.

lag The amount of time between the finish of a predecessor task and the start of a successor task.

lead The amount of time that a successor task is permitted to start before its predecessor is finished.

milestone A project event that represents a checkpoint, a major accomplishment, or a measurable goal.

negative float (negative slack) Unscheduled delay before an actual task start; time that must be recovered if the project is not to be delayed.

OBS (Organizational Breakdown Structure) **codes** A set of codes used to identify tasks by resource groups in a hierarchy. Often used to reflect departmental structure in a company or code of accounts. This structure can be used for filtering tasks.

PERT chart (Project Evaluation and Resource Tracking) Also called a network diagram. A graphical depiction of task dependencies that resembles a flow chart. Dependencies are indicated by connecting lines or arrows that indicate the work flow

predecessor In a dependency relationship between two tasks, the predecessor is the task that must be started or completed first.

resource Any person, group of people, piece of equipment, or material used in accomplishing a project task.

resource-driven Task durations determined by the program based on the number and allocation of resources, rather than the time available. Both tasks and entire projects can be resource-driven.

resource leveling The process of resolving resource conflicts. Most project management programs offer an automated resource leveling routine that delays tasks until the resources assigned to them are available.

subproject A group of activities treated as a single task in a master project schedule. Subprojects are a way of working with multiple projects that keep all the data in one file rather than independent files.

successor In a dependency relationship between two tasks, the successor is the task that must await the start or completion of the other.

WBS (Work Breakdown Structure) codes A set of codes used to identify tasks in a hierarchy. Many programs associate these codes with an outline structure. The WBS codes can be used to filter the schedule.

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task links intact. If the dates for a linked task slip on an individual schedule, a reminder of the impact for another manager's schedule is graphically portrayed on the Gantt chart as a conflict line. When the projects are brought together again, changes in linked tasks update the master plan and are reflected on the cross-project Gantt and PERT charts. This type of multiple-project linking is the first step toward incorporating workgroup functionality in project management programs.

Although it isn't a new feature, per se, some programs have increased the number of tasks they can manage in a project. CA-SuperProject, for example, can now handle 16,000 tasks per project, up from 2,800 in its last DOS version; MS Project has ramped up its capacity to 9,999 tasks from 2,000 in Version 1.0. These increases in task-handling capability are a blow to high-end project management products, which have always claimed to be the only ones capable of managing large projects.

PERFORMANCE ISSUES

PC Magazine Labs tested our group of mainstream project management packages to evaluate their speed in basic operations like program and file loading, recalculating, and printing. The scenario used a telecommunications project consisting of 138 tasks and spanning an estimated 39 working days. The project utilized 18 different resources, with 95 specific task assignments. You can check our performance test evaluation, below, to see who turned in the fastest times. While speed is always an issue to consider when selecting software, it isn't everything—especially in this software category.

One central test of project management software is the ability to automatically resolve resource conflicts—known in the trade as *resource leveling*. This is done by reallocating tasks whose resources are overbooked, which results in a longer project schedule. All other things being equal, the best resource-leveling solution is the shortest schedule.

As initially designed, our test project has adequate resources and, thus, few resource conflicts. Therefore, in order to test our project management software packages' resource-leveling capabilities under more challenging and realistic conditions, we doubled the magnitude of the project (and hence the resource requirements) while keeping resource availability the same. The results of these resource-leveling tests are included in our project management performance test evaluation that appears later in this feature.

ART VS. SCIENCE

In interpreting these results, it is important to understand that resource-leveling algorithms are complex; they react to changes in resource availability in very different ways. In particular, as resource availability becomes increasingly constrained, different algorithms may give varying solutions.

Our results, then, give some indication of the overall quality of each package's prowess at automatic leveling, but they are by no means conclusive. In fact, there is so much potential variability that we cannot conclude that any single package is clearly superior on the basis of this testing.

Realistically, automated resource leveling should be looked upon more as a guide than an objective solution: While time management is a science, resource management is an art. The best project management software tools facilitate the testing of various scenarios instead of merely calculating the one best way to get the job done.

For a deeper look at this issue, you might want to acquire the *1992 Resource Leveling Study* ($500), published by 1 Soft Decision Inc. (contact 1 Soft Decision at P.O. Box 6123, San Rafael, CA 93903-0123; 415-491-1010).

Prices for the packages reviewed in this article vary from $549 for InstaPlan EMS to $895 for CA-SuperProject for Windows, with most of the others retailing for around $695; cost is not a major differentiator here. The reviews that follow should give you a good overall sense of the individual products and, perhaps, a feel for what it might be like to work with them. The features table will let you compare the products on a detailed, feature by feature level. Whatever your familiarity with the art and science of project management, you're likely to find a product in this group that suits your experience and needs.

Computer Associates International Inc.

CA-SuperProject for Windows

ALL REVIEWS BY
HENRY FERSKO-WEISS

High performance and richness of features have long been CA-SuperProject's claim to fame. The latest version of the program, the $895 CA-SuperProject for Windows, still offers both and is now decked out in an interactive graphical interface (although it has no new project management features). Unfortunately, Computer Associates has failed to take full advantage of the command flexibility of the Windows environment. As a result, SuperProject remains a powerful program that lacks the stylistic elegance of other Windows-based project managers.

The depth and power of SuperProject's feature set is obvious when you call on the scheduling tools. You can schedule as many as 16,000 tasks per project—up from about 1,200 in the DOS version—adjust task durations down to the minute, set up resource-driven tasks, indicate lags and lead by duration or a percentage of the predecessor's duration, do optimistic-, most likely-, and pessimistic-probability analy-

FACT FILE

CA-SuperProject for Windows, Version 2.0

Computer Associates International Inc., One Computer Associates Plaza, Islandia, NY 11788; 800-225-5224, 516-342-5224

List Price: $895, upgrade from DOS-based Version 2.0, $195, upgrade from any other project manager, $225
Requires: 2MB RAM, DOS 3.1 or later, Microsoft Windows 3.0
In Short: CA-SuperProject for Windows takes the DOS version of this product and translates it into the Windows environment with hardly a change in appearance or features. The principal new items are some icons and functional password security. The program does not fully utilize Windows' potential, and you may have difficulty accessing all of your data. On the other hand, the package produces the best resource-leveling schedules and has more features than most of the competition—but some programs are catching up.

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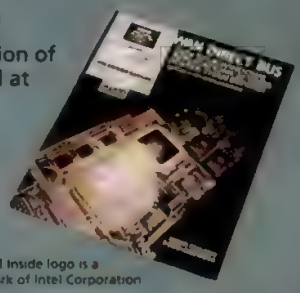

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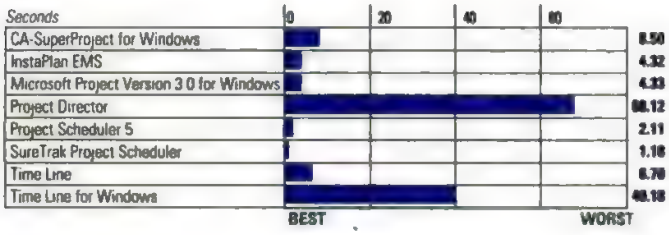
Performance Tests: Project Management

Don't expect to find a clear overall winner on our performance tests. Of the tests we conducted, probably the most significant from a real-world user's standpoint are those involving the speed of project recalculation after changing task durations and the speed of automatic resource-leveling calculations.

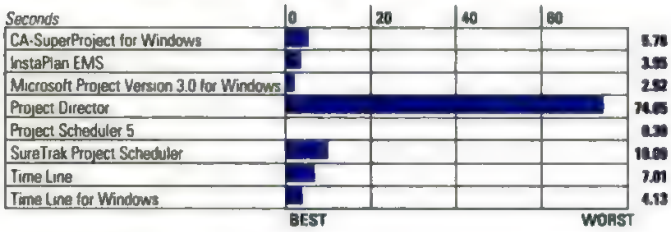
PROJECT LOAD

The **Project Load** test measures how long it takes to load our test project in each of the programs.



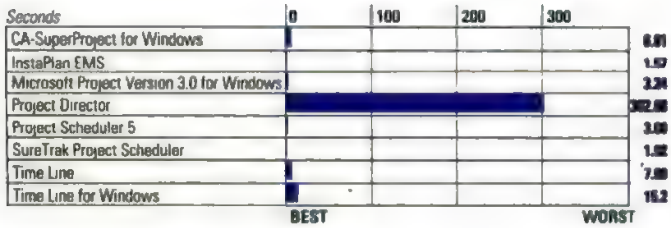
CHANGE TASK DURATION RECALC

The **Change Task Duration Recalc** test measures how long each program takes to recalculate the project schedule when a task's duration is changed.



SAVE PROJECT TO DISK

Once the duration of one task is changed, we time how long it takes to save the project and report that time in the **Save Project to Disk** test.

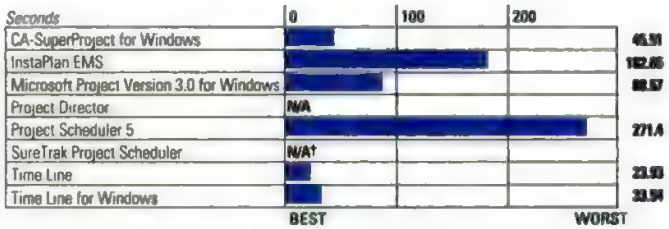


HOW WE TESTED

We performed all tests on a Compaq 386/25e with 8MB of memory and a 330MB hard disk running Compaq DOS 5.0. We tested Windows programs using Microsoft Windows 3.0a.

RESOURCE LEVEL RECALC

Our **Resource Level Recalc** test measures how long it takes each of the programs to recalculate the project schedule after the number of people available to work on a project is reduced; this causes resource overloads that the program automatically resolves or *levels*

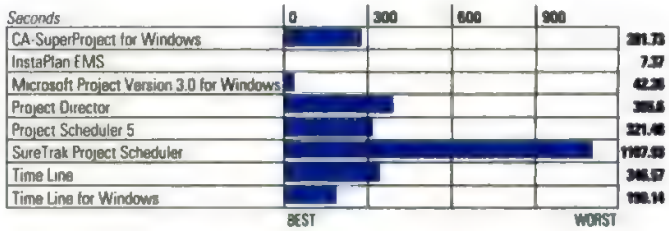


N/A—The product was unable to complete our test

N/A†—The product does not have this feature

FILTER AND PRINT

In each program we use filters to create a two-week status report. Our **Filter and Print** test measures the total time required to filter the project schedule and print it. Timing ends when control of the keyboard is returned to the user after our report is directed to the printer.



AUTOMATIC RESOURCE LEVELING

The **Automatic Resource Leveling** test reports the date each program estimates our test project will be completed after changes are made in our Resource Level Recalc test. The earliest date indicates the most effective resource leveling.

N/A—The product was unable to complete our test

N/A†—The product does not have this feature

ses, split tasks, and create hammock tasks. One unique feature lets you assign a "work between" constraint, so a task must start and finish within a specified window of time. In addition, SuperProject lets you view more than one project at time, which facilitates working with multiple projects. You can level and report across projects, then unlink them while retaining schedule changes.

RESOURCE-LEVELING EXPERTISE

SuperProject also shines in the resource management area. You can define an unlimited number of resources for a project and vary their availability by work-shift start time, regular and overtime hours, units, cost rates, and individual entries on the resource calendars. You can make partial resource allocations, repeatedly assign resources to a task, indicate must-start or -finish dates for the assignment, and introduce an efficiency factor.

SuperProject outclassed the competition in PC Magazine Labs' automatic resource-leveling tests, producing the tightest schedule of any product in the review group. Leveling speed was third best, behind Time Line 5.0 and Time Line for Windows.

SUITABILITY TO TASK

CA-SuperProject for Windows

	POOR	FAIR	GOOD	EXCELLENT
Planning a project	●	●	●	●
Managing a project	●	●	●	○
Communicating about a project	●	●	●	○
Workgroup project management	●	●	●	○

SuperProject's tracking and reporting features help you closely monitor a project's progress. The program calculates remaining hours, units, costs, and percent complete. You can overwrite any of these with your own figures, which affect the remaining calculations. You can easily report on any aspect of a project. Finally, SuperProject's report facilities allow you to change your text's typeface and point size.

LAYOUTS GALORE

SuperProject does a fine job with display layouts. Every one of the main project views—including Task and Resource outlines—offers a selection of preset layouts. The Task Outline, for example, comes with 13 layouts. Some show table views, others show tables with Gantt charts. You can create your own layouts by picking the data columns, adjusting the outline preferences, and changing display characteristics. These layouts make working with project data easy.

SuperProject has other notable features including outlining that works with tasks, resources, dates, and accounts. The program even lets you shift among a beginners' "experience mode" and four expert modes, which progressively reveal more commands and data. For example, the Baseline Compare mode adds baseline fields, and the Earned Value Analysis mode adds performance measurement calculations. Unfortunately, these experience modes introduce extra command layers between you and the project information.

Another major ease-of-use feature is the Assist mode. It displays continuous context-sensitive help at the bottom of the screen and automatically moves you to the next editable field.

POWERFUL, BUT NOT PRETTY

SuperProject gives you some, but not enough, of the graphical bounty you expect in a Windows application. For example, you can change the colors of most on-screen elements, adjust Gantt bar symbols, and interactively alter a task bar's start date or duration using the mouse. However, you can't change the display fonts or headings, set column width or height for table displays, or graphically reposition percent complete on the Gantt chart.

SuperProject's dedicated task buttons, new to this version, also fail to fully exploit Windows' power. Buttons are provided for adjusting your project view, for example, promoting or demoting tasks on the outline, or displaying a histogram subscreen, but buttons for functional operations like saving a project, printing, cutting and pasting, or leveling resources are regrettably scarce.

Perhaps more unfortunate than the display omissions is SuperProject's somewhat awkward way of viewing and working with project data. An example of this is the Task Outline, the main project-building workspace consisting of a spreadsheet area and a Gantt chart. Both areas have scroll bars, but the Gantt chart appears as a column in the spreadsheet (the default position is column two). Accordingly, when you scroll past column three, you loose sight of the Gantt chart, making it difficult for you to keep a broad view of your project in mind as you examine or change details.

In CA-SuperProject for Windows' PERT chart you can control the information displayed in the boxes, but here only the task ID is shown to get more of the chart on-screen at once.

SuperProject also falls short in the way it makes you edit or view task details: You must call up a form that holds basic date, duration, and resource information, but unlike the forms in Microsoft Project or Time Line for Windows, it fills the whole screen, which, again, forces you to choose between details and the broad view—you can't see both at once.

CA-SuperProject for Windows looks the same as its DOS counterpart, but offers some added graphical elements, such as task buttons. Unfortunately, the package hasn't utilized the Windows environment to its fullest and data is still hard to get at. But when it comes to project management features, SuperProject continues to stand equal to the best of the competition.

Micro Planning International Inc.

InstaPlan EMS

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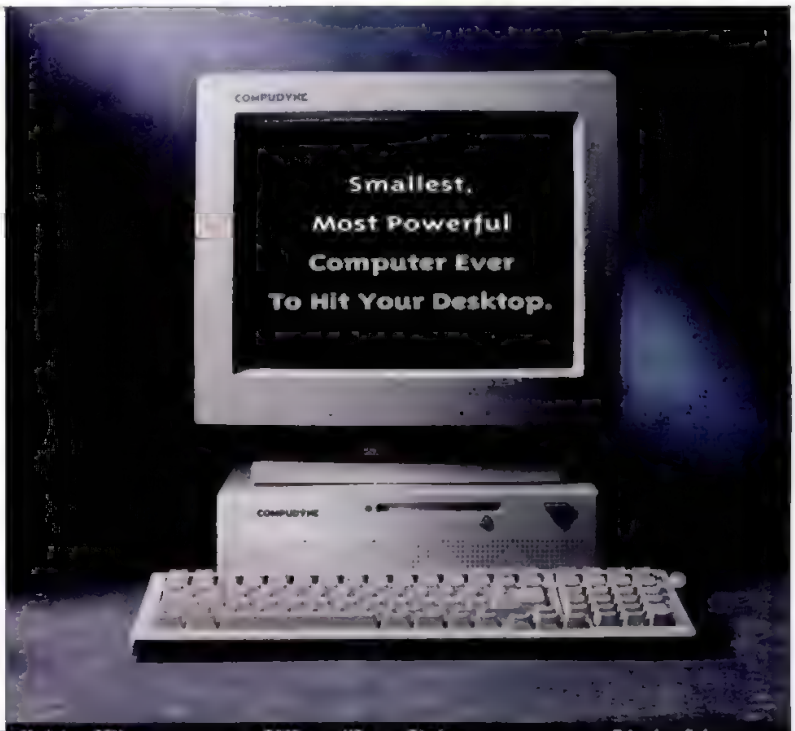

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3DN/33	Intel 386/DX-33 MHz	4	130	1024x768 Resolution .28 14" SVGA Color Monitor	$1,699 $63/mo*
4DX/33	Intel 486/DX-33 MHz 128K Aux. cache	8	210	1024x768 1MB video RAM .28 14" Non-interlaced Multisync Color Monitor	$2,599 $96/mo*

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486SX/25	Intel 80486SX-25 MHz Built-in 8K CPU cache	2 standard 32 max	80	as above	16 bit SVGA card 14" 1024x768 SVGA Color Monitor	$1,299 $48/mo*
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486DX2/50 CACHE	Intel 80486DX2-50 MHz 128K CPU cache New Double Clock CPU	4 standard 64 max	130	as above	as above	$1,999 $74/mo*
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limited functionality and major shortcomings in display control, the program is easy to use, logical, and, at $549, comparatively inexpensive. In this latest version, you get support for expanded memory plus enhanced subproject capability.

InstaPlan uses the outline approach for setting up scheduling, which makes the job of building a project simple. In the default Activity view, you list task names in an outline hierarchy, and then tab once across the screen to fill in task durations. Durations can be expressed in work time (5d for five days), elapsed time (14we for 14 weeks), or work effort (25md for 25 man-days). There are no complex forms to fill out. The Gantt chart, PERT chart, and spreadsheet all display this task outline on the left side of the screen.

Resources, too, are organized in an outline, which appears in the Loading, Resources, and Calendar views. InstaPlan keeps activity and resource data to a minimum. For example, you can't split task durations, which makes it hard for you to accurately model real-world situations. Version 4.0 has added work breakdown structure (WBS) codes, but only as part of the task name. The program won't automatically generate the codes. You can specify a WBS edit mask, but the program doesn't prevent you from using the same code for different tasks, which causes considerable confusion when you try to use those codes for reporting.

IN WITH THE OLD

InstaPlan has one of the oldest interfaces in this review group. The program starts up with white on black screens, has plain border treatments, and data in the spreadsheet views is crunched together. You can add colors to the screens, but the palette has a fairly narrow range. InstaPlan's charts share this primitive look.

The program's commands appear in pop-up Lotus 1-2-3–style menus at the bottom of the screen. This version of InstaPlan has added mouse support, but unfortunately it's poorly implemented. The main problem is the lack of a mouse cursor. The mouse moves the highlight bar, but you can't tell how far you're going.

InstaPlan's Gantt chart uses solid bars for critical tasks and broken bars for noncritical tasks. It's difficult to distinguish between summary and individual tasks because they use the same bar style and color.

The PERT chart is the poorest of the products reviewed here. It is allotted only half of the screen area—a task outline takes up the left half—so you see just a small part of your project at one time. Also, the vertical orientation, and the fact that you can only move through the chart in task order, makes it confusing.

InstaPlan lets you view both a task outline and a PERT chart in a split-screen view. Because you can't see many tasks at once, though, it's hard to get a sense of your project's structure.

WEAK RESOURCE FEATURES

InstaPlan's most glaring limitations are in the resources area. Although you can record the number of resources available and list a cost rate, you can't indicate an inflation rate, use split allocations, or assign fractions of a resource. As a result, it's difficult to model allocations precisely. However, you do get individual resource calendars, which let you set the number of hours worked and nonwork days for each resource.

Automatic resource leveling is not InstaPlan's forte. In PC Labs' resource-leveling tests, it turned in the worst performance in the review group. When it came to speed, InstaPlan gave a mixed performance. The resource-leveling test took the second longest of any program reviewed, and took twice as long as the next slowest product—a surprising result, considering the poor leveling job it did. On the other hand, the program proved faster than all the others at saving a project, came in second for loading the project, and was third for recalculating the schedule after a task change.

RESOURCE ALLOCATION

InstaPlan lets you share resources among projects, but only if they are combined as subprojects in a larger schedule. Project order in a multiple project outline is used as the priority indicator when leveling resources. New in Version 4.0 is the ability to use a different scheduling method—normal or deadline, for example—in each of the linked projects. Like other products, InstaPlan restricts you to one method per project. You must either schedule forward from a start date for the project or backward from an end date. Since this latest version of the program supports expanded memory, you can create projects with as many tasks as memory allows: roughly 2,500 per megabyte of available memory.

TRACK RECORD

InstaPlan does a good job of tracking project progress. You can enter percent progress based on the degree to which the objective of a task has been accomplished. It's not a measure of time or spending. You can also pick several different earned value methods that let you calculate the value of work accomplished in dollars and cents based on the cost rates for resources. For example, you could choose to have the earned value remain at zero until the task is complete, or accurately reflect the current progress on a task. If you've chosen the Keep History option, every update is recorded and can be used to spot trends.

Reporting is the weakest part of the tracking features, even though InstaPlan has made improvements in this area, such

SUITABILITY TO TASK

InstaPlan EMS

	POOR	FAIR	GOOD	EXCELLENT
Planning a project	●	●	○	○
Managing a project	●	●	●	○
Communicating about a project	●	●	○	○
Workgroup project management	●	○	○	○

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FACT FILE

InstaPlan EMS, Version 4.0

Micro Planning International Inc., 3801 E. Florida Ave., #601, Denver, CO 80210; 303-757-2216; fax 303-757-2047

List Price: $549
Requires: 640K RAM, DOS 2.1 or later
In Short: InstaPlan EMS 4.0 offers ease of use, speed, and a relatively low price. With its new support for expanded memory, you can build very large projects—about 2,500 tasks per 1MB of available RAM. This version also adds some new subproject features, support for plotters and PostScript printers, and mouse support. On the other hand, the package still offers somewhat limited functionality (particularly in the resource area), very little control over the screens and reports, and a primitive feel in its design.

(468 ON READER SERVICE CARD)

as support for plotters and PostScript printers. Unfortunately, the program still gives you almost no control over how reports appear, and decidedly limited control over the contents. And if you want to print a PERT chart, you have to exit InstaPlan and load a separate utility program.

If you can accept InstaPlan EMS 4.0's feature limitations and primitive design, it offers you an easy way to handle basic critical-path-style project management.

Microsoft Corp.

Microsoft Project Version 3.0 for Windows

For two years, Microsoft Project enjoyed the distinction of being the only major project management package running under Windows. Microsoft used this advantage, as well as Project's excellent approach to flexible project views, ease of use, and customizing abilities, to help it garner a strong market position. Now, with a number of other Windows-based programs available, the competition has stiffened. But at the same time, there is the next generation of Project, Version 3.0 (there was no 2.0 version for internal reasons). And again, Microsoft has moved the target further ahead, while keeping the price at $695. Version 3.0 is easier to use and more interactive, and has refined reporting features. Further, it now supports DDE (dynamic data exchange) and OLE (object linking and embedding) and has dramatically improved its resource-leveling capabilities.

Project's interface remains its most impressive feature. You can add color everywhere, and although the color palette isn't very extensive, you get enough choices to make all the task bars stand out on the Gantt chart. Bars can have different fill patterns as well as different start and end symbols. You can color text separately and also change fonts and point sizes.

Flexible control over the screen's appearance is just the beginning. You can also control the project data you work with by varying views, tables, and filters. Views include the Gantt chart, PERT chart, and resource spreadsheet. A number of these views have a spreadsheet section to which you can apply a table. For example, in the Gantt view you can define up to 100 columns. This lets you pick the data fields you want for any phase of planning. The Gantt spreadsheet uses the outlining method to generate automatic task summarization.

You can use filters to focus your view of a project even further. For example, you might choose to display or highlight only the critical tasks, or overallocated resources. You can also base filters on calculations, such as a comparison between scheduled and planned costs. Two views can be displayed in Microsoft Project simultaneously, and these combination views—as well as custom-built single views—can be saved and placed on the view menu.

SUITABILITY TO TASK

Microsoft Project 3.0 for Windows

	POOR	FAIR	GOOD	EXCELLENT
Planning a project	●	●	●	○
Managing a project	●	●	●	○
Communicating about a project	●	●	●	●
Workgroup project management	●	●	●	○

AN EMPHASIS ON USABILITY

Project's interactive operational controls make creating a schedule easy. On the Gantt chart, you can change a task's start date, duration, and completion percentage simply by dragging its bar, or portions of it. You can also use the mouse to drag a pane divider to open more of the spreadsheet, or change the sizes of columns and rows.

Project 3.0 also has a toolbar. Its icon

buttons let you cut, copy, paste, link, and unlink groups of tasks, find overallocated resources, bring up various data entry forms, and run macros. You can customize a button's appearance and function through a dialog box. Project comes with a large number of button icons to chose from, and also lets you create your own. You can attach your button to any command, macro, or custom view you choose.

Another enhancement in Version 3.0 is the increased use of double-clicking. For example, if you double-click on a column heading, a dialog box pops up for defining and naming that column. Double-click on the connecting line between tasks on the PERT chart and the Dependency dialog box appears. The combination of flexible icon buttons and double-click operations gives Microsoft Project a dazzling array of mouse-controlled shortcut tools that no other Windows product can match.

Although its polished controls make Project pretty easy to learn, Microsoft has added an interactive learning device that it calls PlanningWizards. PlanningWizards steps you through any of four topics—creating a new project, working with columns, setting preferences (like colors or date-and-time formats), and resolving conflicts—providing explanations so you can learn the program while you work.

SKILLFUL SCHEDULING

Project is also adept at scheduling tasks and resources. You can set any one of six time constraints; indicate task priority; apply resource-driven scheduling to a whole project, a resource group, or individual tasks; and split tasks during leveling. The package also lets you manage up to 20 connected or independent projects.

While Project 1.0 was hopeless at resource leveling, the latest version has much-improved resource management facilities. Version 3.0 enables both partial

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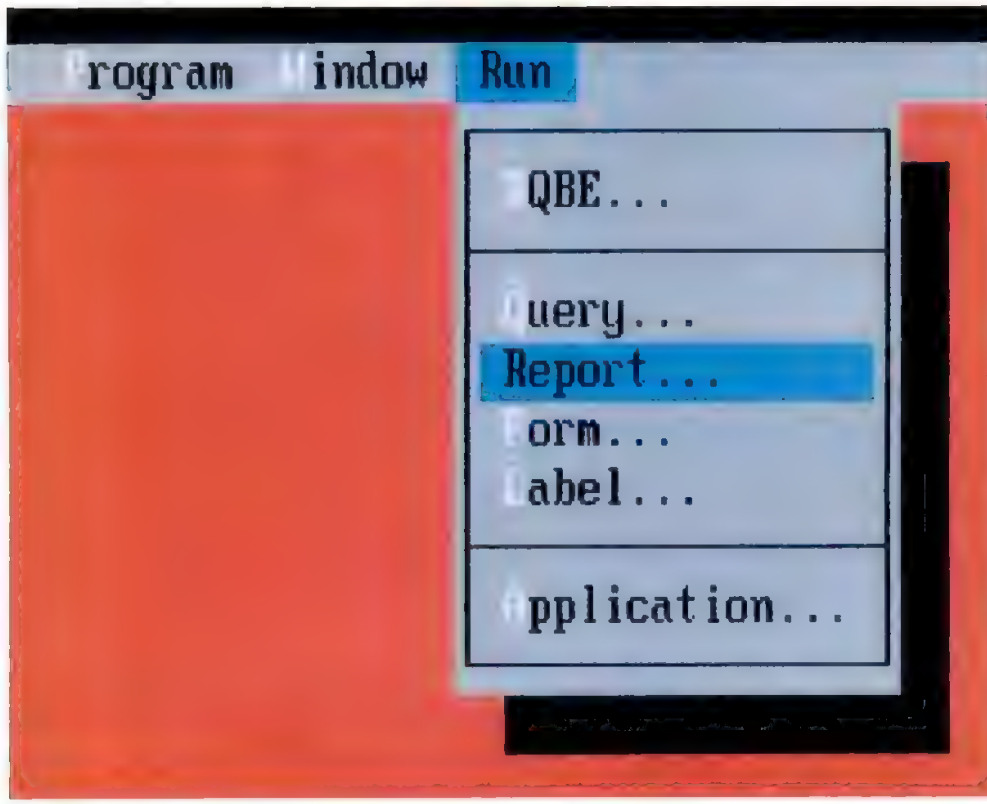

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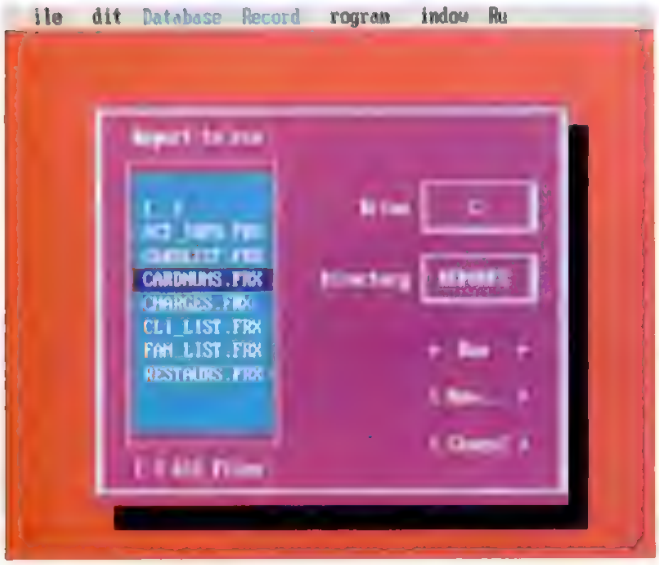

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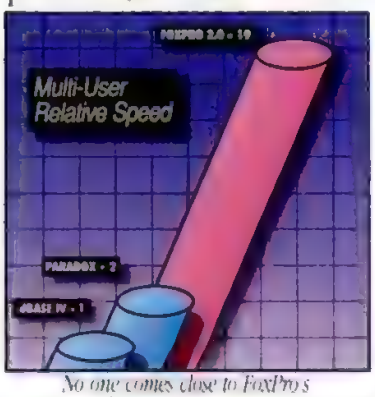

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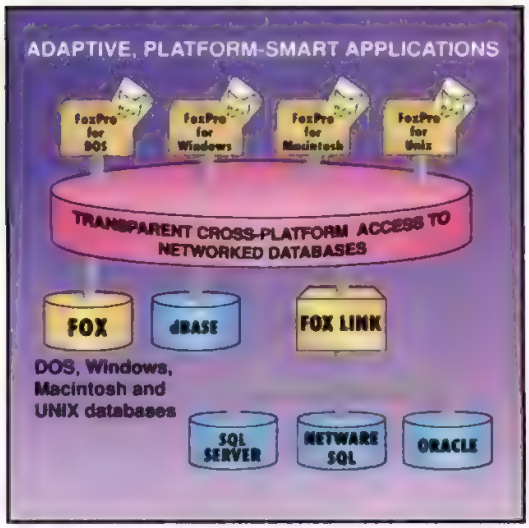

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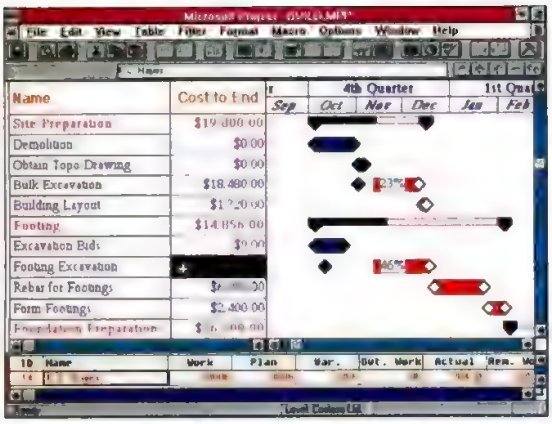


In this Microsoft Project Gantt chart, the dateline headings, column headings, summary tasks, and detailed tasks all use different typography.

resource assignments and variable resource loading. You can also record an overtime rate, specify when during a task duration costs should be applied, group together resources, and apply a resource code to the group. Resources can now be leveled down to the minute, which greatly improves the program's performance with tasks of short duration. This was evident on PC Labs' leveling test where Project tied for second.

As for speed, Project did well in the tests for loading, recalculating the schedule, and saving. However, the resource-leveling time was poor.

Other enhancements to Project include a multipage print preview that can display 32 pages at once, a monthly wall calendar report, a spell-checker, and support for both DDE and OLE. This last feature lets you integrate your project planning with other applications, such as Microsoft Excel, or embed Gantt charts in programs like Microsoft Word for Windows or PowerPoint.

When Microsoft introduced Project two years ago, its main focus was the interface. Version 3.0 makes the interface even better and adds some important project management features. The result is a well-rounded product with solid project management features that let you closely model most real-world situations. Microsoft Project gives you extremely flexible views of your project, and offers outstanding control over the appearance of text screens and charts. This program should appeal to any manager who uses Windows.

EDITORS' CHOICE

Microsoft Project Version 3.0 for Windows

Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080; fax 206-936-7329

List Price: $695, upgrade from previous version, $149
Requires: 2MB RAM (3MB recommended), DOS 3.1 or later, Microsoft Windows 3.0 or later
In Short: Microsoft Project set the standard two years ago for the graphical user interface in a project management program. In Version 3.0, it has made the interface even better by increasing the use of double-clicking and adding customizable task buttons. The buttons let you invoke operations, macros, or views with one mouse click. Other new features include partial-resource allocation and variable resource loading, better resource leveling, and multipage print preview. All in all, an excellent package.

? 469 ON READER SERVICE CARD

adRem Technologies Inc.

Project Director

The makers of Project Director, adRem Technologies, see project management differently from its competitors. The company believes that most projects don't accurately fit the static model where task durations are clearly known ahead of time and fixed, and where pools of resources are virtually interchangeable. Projects today, adRem claims, are more likely to have fluid durations based on dynamically changing goals. adRem also sees the resource pool as consisting of "knowledge workers" who are not interchangeable.

To manage such projects, the $695 Project Director offers a unique set of project management features: the ability to enter management criteria; a Pareto chart, which is a special dual-*y*-axis bar/line chart for analyzing how effectively the most critical resources are being utilized; a PERT chart with task boxes that can hold free-form text; and risk-analysis tools.

Since Project Director runs under Microsoft Windows, it carries the usual stamps of this environment: scroll bars, pull-down menus, and an iconized toolbar. The program conspicuously lacks control over screen appearance, however. You can't change colors or alter the appearance of chart elements either, although you can change text fonts and point sizes.

When you open a project, the program automatically opens three windows: a Gantt chart, a PERT chart, and a resource histogram. These windows immediately minimize to icons at the bottom of the screen. Having icons for these fundamental project views makes going back and forth between them fast and easy.

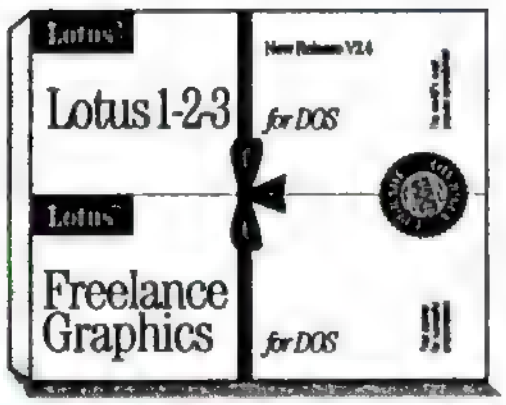
NONTRADITIONAL PERT

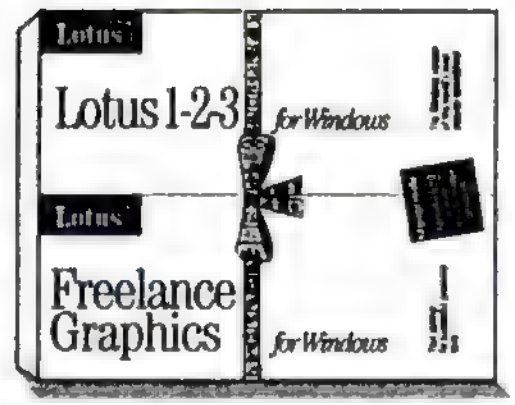
The most logical place to begin designing a project in Project Director is the PERT chart, which works somewhat differently from those in other PM packages: You create new task boxes by clicking on an icon on the toolbar and then dragging open a box from any location on-screen. You can vary the box size to accommodate up to 900 characters of descriptive text, which could even be used, for example, to explain how to perform a particular job. You can also display as many as 16 data fields arranged around the central text area. As with traditional project management PERT charts, you can drag links between task boxes to indicate the project's work flow.

SUITABILITY TO TASK
Project Director

	POOR	FAIR	GOOD	EXCELLENT
Planning a project	●	●	●	○
Managing a project	●	●	●	○
Communicating about a project	●	●	○	○
Workgroup project management	●	○	○	○

Project Director's PERT chart has several other unusual features: Task boxes can be dragged on-screen to change the end date. A text icon lets you create a text-only box (it holds no task data and can't be connected to tasks by dependency links) anywhere on the PERT chart. You can group tasks together by drawing a box around them and assign an icon to the group. For example, a Space Shuttle project might be organized in a series of pictures representing launch routines such as refueling and lift-





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off. Click on the image and you see the appropriate task boxes.

CONVENTIONAL GANTT

The well-designed Gantt chart is much more traditional, with its spreadsheet area on the left and bar chart on the right. Tasks may be shown in an outline format with the resources for a task as the lowest level of the outline. Each resource allocated to a task has its own bar on the chart.

For each task you can record an ID number, a work breakdown schedule (WBS) code, a description, a priority, optimistic and pessimistic factors to be used in estimating durations, must-start and must-end dates, and resource- or duration-driven status. Task dependencies are of the finish-to-start type only, and can have leads or lags.

Resources are defined as individuals—John Doe the engineer, for example—or as types, such as engineers in general. You also enter standard cost and availability information for each resource as well as a maximum availability and overtime rate.

RESOURCE MANAGEMENT

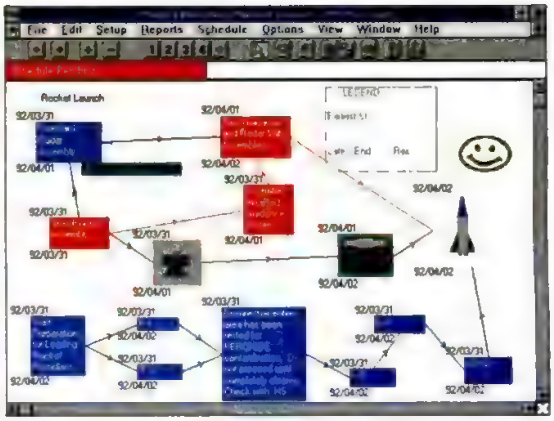
At the heart of Project Director is the resource scheduler, which determines the start and end dates of tasks, assigns individual resources, allocates them by actual days and hours, and calculates the critical path. No other project management package automatically assigns resources, thus determining durations as part of its scheduling function. This methodology makes sense for projects where durations and resource allocations are open questions, but not all projects fit this mold. Unfortunately, Project Director doesn't give you a choice, but forces you to work its way.

The resource scheduler bases its decisions on a profile of management objectives. At the heart of this profile is a governing statement regarding what type of risk to most stringently avoid: cost overruns, missed deadlines, or time spent on the project in general. Further, management must decide if task must-dates can slide, if resources should be allocated at their standard or maximum availability settings, and if individual or system work limits should be imposed. Because the schedule is based on a profile, it's easy to change it if the management criteria change. So, if costs become the primary concern when the project is in midstream, the program can quickly factor in this new criterion and alter arrangements accordingly.

Since Project Director isn't designed to work with pools of interchangeable resources, it was unable to perform the PC Labs' resource-leveling test. In all of the other tests, it was the slowest package we tested.

CLOSE MONITORING

Once you've begun work on a schedule, Project Director lets you keep a close eye on what's happening by recording time spent by each resource on each task. The program then estimates time remaining, and alters schedules as necessary. You can record the actual type of work done by a resource, such as preparation and travel. A Pareto chart then shows a vertical bar for the hours spent at each activity, and displays a line graph for the percentage of overall work each category represents. This gives a manager invaluable information when trying to discover why a project isn't meeting the management criteria.



Project Director's unusual PERT chart can hide groups of tasks under bitmapped images that represent portions of the project—here, a satellite and a fuel tank.

Project Director 2.0 works best with fluid projects that start out with unknown durations and resource usage. No other package can model this type of project as well. It can also be used for traditional projects, but only if their resource utilization is simple and not group-oriented. If you're used to traditional project management software, be prepared to spend time learning a whole new set of concepts and techniques.

FACT FILE

Project Director, Version 2.0

adRem Technologies Inc., 3 Breda Ct., Richmond Hill, Ontario, Canada, L4C 6E1; 416-886-7899; fax 416-470-6276

List Price: $695.
Requires: 640K RAM, DOS 3.0 or later, Microsoft Windows 3.0 or later.
In Short: Project Director is a most unusual project management program. It's designed to handle projects of an indeterminate nature, where task durations and resource usage are not clearly known ahead of time. It introduces new techniques, such as a management objectives profile, a Pareto chart for analyzing how resources spend their time, and a PERT chart that allows for free-form text inside and outside of task boxes. If you work with projects that suit its philosophical bias, you won't find another program to match it, but it's less able to work with construction or static project types, and isn't easy to learn

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Scitor Corp.'s $695 Project Scheduler 5 blends clear, clean graphics with a powerful set of project management features and superior speed. The product has boasted this balance since the first release of Project Scheduler 4, almost four years ago. This latest version adds some unique workgroup features and network capabilities.

Although Project Scheduler 5 (PS5) is a DOS-based program, it has a proprietary graphical user interface replete with pull-down menus, scroll bars, and dialog boxes. Unlike Windows programs, you can run it on virtually any system, as long as it has 512K of RAM. You can't control the use of color, chart styling, and text fonts, but the defaults are pleasing.

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★FontMonger for Windows

FontMonger bridges competing font technologies by letting desktop publishers easily convert between Adobe PostScript Type 1 and Type 3, Intellifont, Nimbus Q and TrueType (for Windows 3.1). Converted fonts can be saved for IBM PC and compatibles, Macintosh and NeXT computers. FontMonger lets you modify character outlines with built in drawing tools or generate customized typefaces and characters such as obliques, fractions and small caps. Copy and paste characters to create a new font. **Publisher: ARES GR3074**

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★WordPerfect® 5.1 for Windows™

WordPerfect 5.1 for Windows contains all of the capabilities of WordPerfect 5.1 for DOS, as well as new features that take full advantage of the Windows graphical user interface. The Ruler simplifies the tasks of adjusting margins, setting tabs, changing line spacing, selecting styles and creating or modifying columns and tables. WYSIWYG editing lets you see all your graphics and fonts on screen. Graphics can easily be moved and sized by using the mouse. You can assign frequently used features and commands to the Button Bar for easy access. WordPerfect for Windows documents are compatible with WordPerfect 5.1 for DOS. **Publisher: WordPerfect Corporation WP1653/5**

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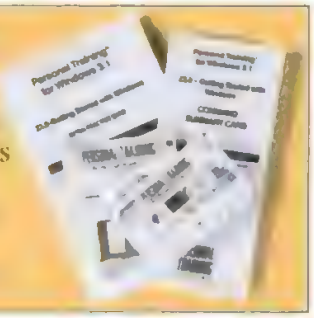

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LN0085	QuickBasic 4 5	65
LN1674	◆Visual Basic	129

Bernoulli PC Powered

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$539

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$39

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$43

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Design precision, to scale (HO, N, O, Z, S, G) layouts using unique track-laying tools. A complete set of drawing tools allows you to add rolling stock, scenery, and structures to your layout. It's better than a model railroad in your basement. **Publisher: Abracadata EN2684**

$35

AUTOMAP

AUTOMAP helps you find the best route for your trip with hundreds of up-to-date color maps, detailed driving instructions and listings of alternate routes. It even prints a map for you. **Publisher: AUTOMAP, Inc. BS5224 $50.**

Bodyworks

Now you can explore the human body's systems, structures, and functions in fascinating interactive detail. Includes a special health section with information on first aid, general fitness, sports injuries, and common illness. **Publisher: Software Marketing ED3034 $49.**

Orbits

Orbits lets you explore the worlds of wonder in outer space. This interactive space simulator and solar system atlas features animation and 3-D graphics. Requires 512K RAM, EGA or VGA color graphics, and supports a mouse. **Publisher: Software Marketing ED3044**

$39

MARCO MEMORY UPGRADES

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4 MB SIMM 70ns (4x9) **MY3390 $159.**

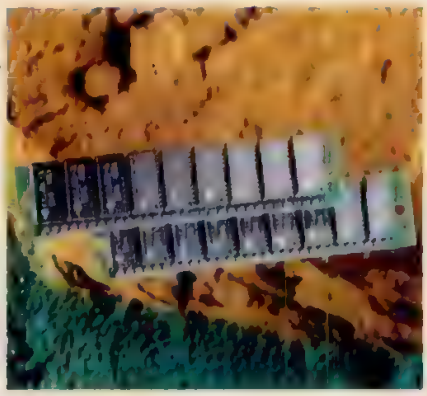
Hewlett Packard Laserjet Memory - fits models IID, III, IIID, IIIP

2 MB Expansion Card **PR2520 $119.**
4MB Expansion Card **PR2530 $189.**

Manufacturer: MARCO International

1 MB SIMM 80ns **MY0004**

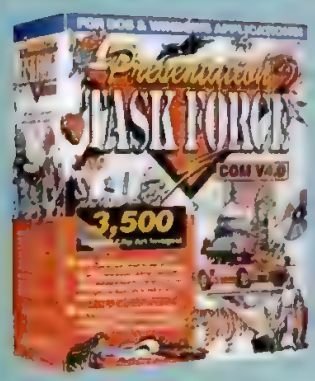
$55



★Adobe Illustrator 4.0 & ★Adobe Streamline 3.0 for Windows Bundle

Adobe Illustrator 4.0 for Windows provides a professional illustration solution for The PC environment. This new version of the program allows graphic artists, designers and desktop publishers to create professional-quality illustration and design. This value packed program includes Adobe Type Manager software (ATM), 40 Adobe Type 1 type faces, the Adobe TypeAlign type manipulation program, Adobe Separator color separation software and a generous selection of Adobe patterns, textures, symbols, and borders. As an added bonus, you also get Adobe Streamline 3.0 for Windows. This new version makes it easy to convert any bitmapped image into color or black-and-white line art. ***Adobe Illustrator Competitive Upgrade also available. Please call.***
Publisher: Adobe GR5143/5

$399



★Presentation Task Force CGM clip art 4.0

Now you can own the clip art PC Magazine recently called "The best CGM clip art package for overall quality and usability." Presentation Task Force 4.0 is the only clip art product to feature over 3,500 high quality, color illustrations in one value packed, comprehensive volume! Use PTF clip art to enhance presentations, newsletters, and spreadsheets created with over 60 leading DOS and Windows applications, including CorelDraw!, Designer, Harvard Graphics, Microsoft Publisher, PageMaker, Persuasion, PowerPoint, Quattro Pro, Ventura Publisher, Word for Windows, WordPerfect, and many more! PTF 4.0 contains people, animals, business symbols, medical illustrations, holidays, sports, military, and environment-related images. **Publisher: New Vision Technologies, Inc. GR3174**

$134

NETROOM 2.0

Now the PC Magazine Editors' Choice winning memory manager is even better. NETROOM version 2.0 has a fully automated installation program which optimizes your PC's memory configuration. Quantum technology relocates your system's BIOS freeing up an incredible extra 96K worth of high DOS. NETROOM goes even further, creating a Virtual Machine of up to 576K for programs and networks, leaving you with up to 626K free! Only NETROOM provides access to extended or expanded memory above 1Mb and works on 8088-386 PCs, running DOS and Windows. **Publisher: Helix** Also available in ***4 - user*** **BS5304 $109** and ***10 - user*** **BS5314 $185** plus ***NETROOM 2.0 with DOS 5.0 Bundle*** **BN0043/5 $99.**

Single user **BS3154**

$59

CIRCLE 225 ON READER SERVICE CARD

▶ SUMMARY OF FEATURES

Project Management

PC EDITORS' CHOICE

Products listed in alphabetical order

■ = YES □ = NO

	CA-SuperProject for Windows	InstaPlan EMS	Microsoft Project 3.0 for Windows	Project Director	Project Scheduler 5	SureTrak Project Scheduler
List price	$895	$549	$695	$695	$695	$795
General features						
Windows interface	■	□	■	■	□	□
Proprietary graphical interface	□	□	□	□	■	□
Disk space required for complete installation	3.5MB	2MB	8MB	1MB	1 5MB	3 5MB
Number of dedicated task buttons for functions or views	25	None	80	17	None	None
Mouse support	■	■	■	■	■	■
Interactive graphics in Gantt charts/PERT charts	■■	□□	■■	□■	■■	■□
Split-screen capability	■	□	■	■	■	■
Multiple graphics view combinations	■	□	■	■	■	■
Data can be carried over to next task/next resource	■■	■■	■■	□□	■■	■■
Maximum number of screen fonts	1	1	200	1	1	1
Control over text colors	■	■	■	□	□	■
Control over column headings	□	■	■	■	□	■
Undo command	□	■	■	□	■	■
Programmable macros	■	□	■	□	■	□
Transfer parts of project to other projects	■	■	■	■	■	□
Task outline with indented levels for children tasks	■	■	■	■	■	□
Maximum number of levels	Unlimited	10	10	99	10	N/A
Resource outline	■	■	□	□	■	□
Maximum number of levels	Unlimited	10	N/A	N/A	5	N/A
Can save and reuse screen or view layouts; can view filters	■■	■■	■■	■■	■■	■□
Boolean operators on filtering	■	□	■	■	□	■
On-line tutorial	■	□	■	□	□	■
Context-sensitive help	■	■	■	□	■	■
Assisted scheduling	■	□	■	■	■	□
Memory utilization						
Extended memory support	■	□	■	■	□	■
Expanded memory support (LIM version)	N/A	■ (3.2, 4.0)	N/A	N/A	■ (4 0)	□
Virtual memory via disk swapping	■	□	■	■	□	□
Charts						
Graphic reports (screen display/report output).						
Gantt chart	■■	■■	■■	■■	■■	■■
Customizable bars	■■	■□	■■	□□	□□	■■
Can show negative slack	■■	□■	■■	□□	■■	■■
Can show free float and total float	■■	□■	■■	■■	■■	■■
Can summarize milestones on one line	■■	□□	■■	■■	■■	■■
Data columns (fields) shown	173/173	User-specified	102/102	14/14	6/6	12/12
Can associate text with bars	■■	□■	■■	■■	■■	■■
Dependency Gantt (shows links with lines)	■■	■■	□□	□□	□□	■■

N/A—Not applicable The product does not have this feature

	PC EDITOR'S CHOICE	
	Time Line	Time Line for Windows
	$699	$699
	□	■
	□	□
	8MB	5MB
	37	53
	■	■
	□□	■■
	■	■
	■	■
	■■	■■
	1	8,000
	■	■
	■	■
	■	■
	■	□
	■	■
	■	■
	Unlimited	7,999
	□	□
	N/A	N/A
	■■	■■
	■	■
	■	■
	■	■
	■	■
	■	■
	■ (3.2,4.0)	N/A
	■	■
	■■	■■
	■■	■■
	■■	□□
	■■	■■
	□□	□□
	16/16	26/26
	□■	■■
	□□	■■

ers, Scitor has made this version's Gantt chart more interactive. You can use the mouse to change a task's duration, alter the start date, or adjust the percent complete. You can also place task-related text in four positions around the Gantt bar. Unfortunately, there are no dedicated task buttons, you can't link or reorder task bars directly, nor can you double-click in the time-scale area of the Gantt chart to shorten or lengthen the time frame (for example, from weeks to months), as you can in the Windows-based Microsoft Project.

SUITABILITY TO TASK
Project Scheduler 5

	POOR	FAIR	GOOD	EXCELLENT
Planning a project	●	●	●	○
Managing a project	●	●	●	○
Communicating about a project	●	●	●	○
Workgroup project management	●	●	●	○

BUILDING PROJECTS

PS5 lets you design a project from any or all of four vantage points—the Gantt chart, the network diagram (PERT), the tree structure diagram, and the job list. PS5's network diagram is one of the best we've seen. Each task box can display up to five lines of information culled from a wide selection of data fields. The connecting arrows won't obscure the project structure, no matter how complex it gets. You can have the program automatically generate the PERT in what it considers the optimal arrangement for visual clarity, drag task boxes around easily, and zoom in at up to five levels of magnification, so you can shift from views with a great many tasks to views that show more individual detail and fewer tasks.

When you enter jobs through one of the chart views, you actually work in a template window below the chart. Charts, lists, and templates all have their own menu bars. Unlike Windows packages, you can't control the size or position of windows, or see more than one chart at a time—except for the Gantt chart and resource histogram combination.

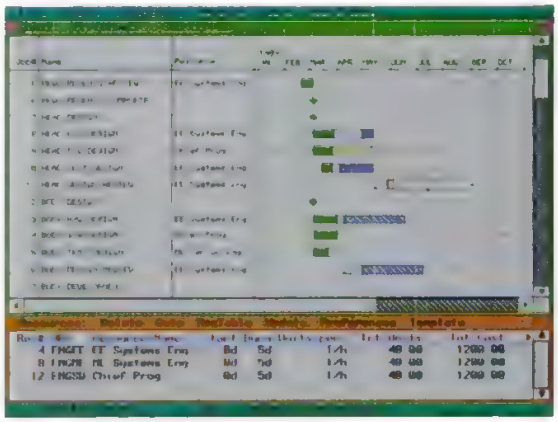
Switching between templates lets you work with tasks, resources, predecessors, notes, and status flags. Status flags control how jobs are scheduled and displayed.

The job list screen lets you see a great many tasks at once, use block edit commands, and indent task names to create something like an outline. Indent levels correspond to PS5's new tree diagram, and can be used to generate the work breakdown structure (WBS) or organizational breakdown structure (OBS) codes. However, without the WBS or OBS codes, indenting does not translate into an automatic summarization of tasks. Another problem here is that you can change the outline and forget to regenerate the codes, causing the two structures to be out of sync. Also, the Gantt chart will not show summarization bars and detail bars at the same time.

RESOURCES

PS5 aptly manages resources, implementing a resources breakdown structure (RBS) code that makes reporting by group easy. Each resource also can have a cost-inflation schedule with 12 changes by date, a maximum number of units available for a specified time period (such as 8/d, eight hours a day), and its own calendar. You can flexibly assign resources by using the Start and Duration fields to indicate precisely which days they will be used. Since you can assign a resource to one task numerous times, you can model complex nonuniform work loads.

If resources are overallocated, you can



Project Scheduler 5's proprietary graphical interface produces clear, well-ordered screens like this Gantt chart, with its associated resource-assignment template.

▶ SUMMARY OF FEATURES

Products listed in alphabetical order ■ = YES □ = NO	CA-SuperProject for Windows	InstaPlan EMS	Microsoft Project 3.0 for Windows (PC Editors' Choice)	Project Director	Project Scheduler 5	SureTrak Project Scheduler
Charts (continued)						
Baseline-versus-actual Gantt	■■	■■	■■	■■	■■	■■
PERT chart (network diagram)	■■	■■	■■	■■	■■	■■
Customizable boxes	■■	□■	■■	■■	□□	■■
Maximum lines of data per box	6/6	6/6	10/10	Unlimited/Unlimited	5/5	3/3
Can control what information appears in boxes	■■	■■	■■	■	■■	■■
Can edit data in task boxes	■■	□□	■■	□□	□□	□□
Number of zoom levels	5 N/A	10 N/A	10 N/A	Unlimited N/A	5 N/A	Unlimited N/A
Can show only filtered tasks	■■	■■	□□	□□	□□	■■
Can show progress	■■	■■	■■	■■	■■	■■
Time-scaled network	■■	□□	□□	□□	□□	■■
Work breakdown structure (WBS)	■■	■■	□□	□□	■■	□□
Resource histograms	■■	■■	■■	■■	■■	■■
Can show regular and overtime hours	■■	■■	■■	■■	□□	■■
Produce histogram for entire resource group	■■	■■	■■	■■	■■	■■
Number of histograms displayed at once	1/1	Unlimited	1/1	999/999	500/500	3/3
Cost histogram charts or curves	■■	■■	■■	■■	■■	■■
Monthly wall calendar	■■	■■	■■	□□	□□	■■
Scheduling						
Maximum number of tasks per project/number of tasks overall	16,000/16,000	16,000/16,000	9,999/Unlimited	10,000/10,000	2,000/Unlimited	4,000/4,000
Priorities on projects/tasks	■■	■■	□■	■■	■■	□□
Effort-driven tasks	■	■	■	■	■	□
Reverse scheduling from end date	■	■	■	■	■	■
Task types:						
As late as possible (ALAP)	■	■	■	□	■	□
As soon as possible (ASAP)	■	■	■	■	■	■
Must-start date	■	■	■	□	■	■
Must-finish date	■	■	■	■	■	■
No-earlier-than date	■	■	■	■	■	■
No-later-than date	■	■	■	□	■	■
Hammock tasks	■	■	□	□	■	■
Durations in:						
Months	■	■	□	□	■	□
Weeks	■	■	■	□	■	□
Days	■	■	■	■	■	■
Hours	■	■	■	■	■	□
Minutes	■	□	■	■	■	□
Automatic WBS codes	■	□	■	□	■	□
User can set the pattern	■	N/A	■	N/A	■	N/A
Link types:						
Finish to start	■	■	■	■	■	■
Start to start	■	■	■	□	■	■
Finish to finish	■	■	■	■	■	■
Start to finish	□	■	■	□	□	□

N/A—Not applicable. The product does not have this feature

	PC EDITOR'S CHOICE Time Line	Time Line for Windows
	■■	■■
	■■	■■
	■■	■■
	6/6	7/7
	■■	■■
	□□	■■
	Unlimited N/A	Unlimited N/A
	■■	□□
	■■	■■
	■■	□□
	■■	□□
	■■	■■
	■□	□□
	■■	□□
	5/All	1/1
	□□	■■
	□□	■■
	7,000/7,000	8,000/8,000
	□■	■■
	■	■
	■	■
	■	■
	■	■
	■	■
	■	■
	■	□
	■	□
	■	□
	■	■
	■	■
	■	■
	■	■
	■	■
	■	□
	■	N/A
	■	■
	■	■
	■	■
	■	■

CONTINUES

level them automatically. PS5 now has the ability to assign priorities to projects and tasks, which gives you a more accurate schedule after leveling. When you level manually, PS5 uses a Search command to find all overallocated resources and display them one at a time in a histogram.

PS5 performed well on PC Magazine Lab's resource-leveling test, producing a schedule that took only one week longer than the best program. However, it was the slowest product at running the resource-leveling test. In the other tests, PS5 performed well. The schedule recalculation test, for example, took less than a second—by far the fastest time.

In general, PS5 has a good complement of tracking features. You can summarize key milestones across the top of the Gantt chart, create a baseline for comparison to actual task durations, and produce a number of cost-comparison charts.

WORKGROUP PROWESS

PS5's most significant change is the addition of workgroup facilities. Department heads or work team leaders can maintain individual schedules for parts of a project that can then be merged into a master plan. The individual schedules have external dependency links at the task level. Slippage shows as a conflict line on the Gantt chart. But the master plan is updated only during status meetings, when the individual projects are reintegrated. You can merge and break schedules apart again while keeping the links and network logic intact. This closely models the way many companies really work.

To help make the workgroup features more efficient, Scitor has added network facilities to the program—such as file locking and passwords. The program will run on any network system that is NetBIOS-compatible.

Project Scheduler 5's balance of features, graphics, and speed makes it a fine product. It offers powerful resource and multiproject management facilities and has an eye-pleasing, easy-to-use interface. Unless you want control over the display graphics, or need more sophisticated scheduling—such as task splitting—this is one of the better products reviewed here.

FACT FILE

Project Scheduler 5, Version 1.5

Scitor Corp., 393 Vintage Park Dr., #140, Foster City, CA 94404; 415-570-7700; fax 415-570-7807

List Price: $695
Requires: 512K RAM, DOS 4.0 or later.
In Short: Project Scheduler 5 achieves quite a good balance between its scheduling features, graphical interface, and speed. Because it's a DOS program, you can run it on virtually any system. This latest version includes project and task priorities and an interactive Gantt chart. It also has workgroup features that let you link multiple projects at the task level and maintain a cross-project network.

471 ON READER SERVICE CARD

Primavera Systems Inc.

SureTrak Project Scheduler

It's easy to envision SureTrak Project Scheduler 2.0 on a computer screen in a construction shack amid T-squares, blueprints pinned to the wall, and gray filing cabinets. Its use of full-screen menus, blocky data entry areas, dotted rows, and keyboard symbols for graphics gives the program a rough-hewn, in-the-field appearance. In fact, the original program, MicroTrak, was written by a construction company in 1983, and was sold almost exclusively in the construction marketplace. In 1990, Primavera Systems acquired the program, gave it a major overhaul, and rechristened it SureTrak. At that time, the interface was improved, the project management terminology updated, and the reports made more generic and less construction oriented.

Now with the $795 SureTrak Project Scheduler, Version 2.0, the push to make the program more appealing to a general project management audience continues. It has better facilities for tracking progress, manages cash flow, and includes two good report writers—one for text, the other for graphics. These features make the program more useful for a broader range of project situations—particularly ones where tracking a revenue

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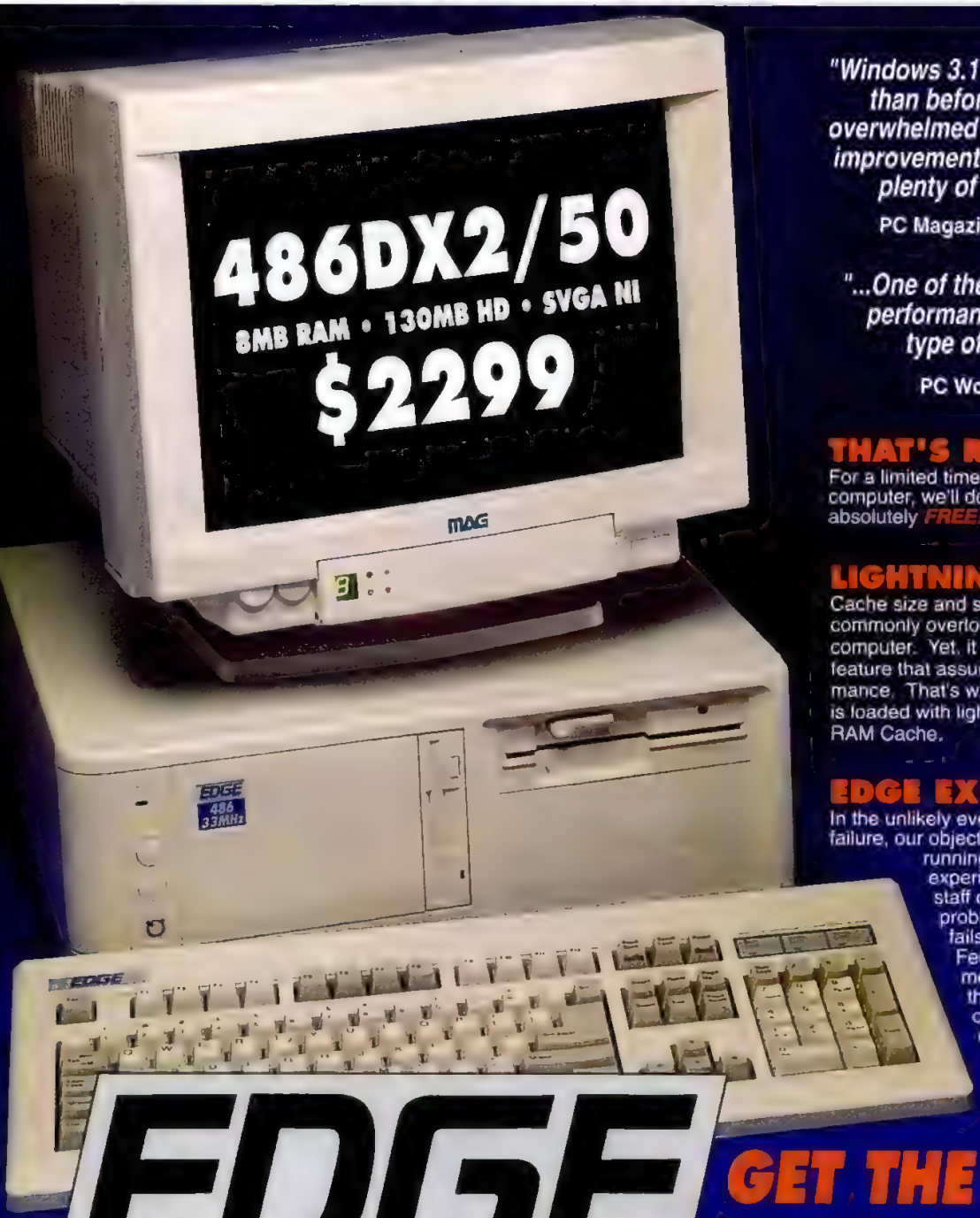

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PC Magazine, April 28, 1992*

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PC World, April 1992*

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386DX/33	80MB	130MB	210MB
14" SVGA 1024I	$1,549	$1,649	$1,799
14" SVGA 1024NI	$1,599	$1,699	$1,849
15" MAG/Eclipse II	$2,049	$2,149	$2,299

386SX/25

- Intel 386SX™ 25MHz Processor
- 2MB of High Speed RAM
- FREE! 2MB RAM Upgrade
- 80MB 17ms IDE Hard Drive, 1:1 Interleave with 32K Cache
- 14" Super VGA Color Monitor 1024x768 Resolution .28 DP
- 1MB 16-Bit Super VGA Card

$1299

386SX/25	80MB	130MB	210MB
14" SVGA 1024I	$1,299	$1,399	$1,549
14" SVGA 1024NI	$1,349	$1,449	$1,599
15" MAG/Eclipse II	$1,799	$1,899	$2,049

FAX/Modem 9624 S/R $99
w/MNP5 and Quick Link II

Internal CD-ROM Drive w/Microsoft Bookshelf $349

- Encyclopedia
- World Almanac
- Dictionary
- Thesaurus
- Book of Facts
- Famous Quotes

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CIRCLE 119 ON READER SERVICE CARD

▶ SUMMARY OF FEATURES

Products listed in alphabetical order ■ = YES □ = NO	CA-SuperProject for Windows	InstaPlan EMS	Microsoft Project 3.0 for Windows (PC EDITORS' CHOICE)	Project Director	Project Scheduler 5	SureTrak Project Scheduler
Scheduling (continued)						
Lead and lag times on constraints	■	■	■	■	■	■
Can set precise work hours on daily basis for project	■	■	■	■	□	■
Can keep notes on the project as a whole	■	■	■	■	□	□
Can keep notes on individual tasks	■	■	■	■	■	□
Can record an overhead cost on tasks unrelated to resource effort	■	■	■	■	□	■
Can split tasks when conflicts occur	■	□	□	□	■	□
Resources						
Maximum number of resources per project/per task	Unlimited/Unlimited	16,000/16,000	9,999/100	999/Unlimited	500/Unlimited	4,000/4,000
Resource codes	■	□	□	□	■	■
Resource calendar	■	■	■	■	■	■
Can set precise hours a resource is available on every workday	■	□	■	■	□	□
Can set number of hours available on any particular day	■	■	■	□	□	■
Can record various availabilities for a resource	■	□	■	■	□	□
Number per resource	Unlimited	N/A	Unlimited	Unlimited	N/A	N/A
Can define overtime hours	■	□	■	■	□	■
Can define resources by percentage	■	■	□	□	■	□
Can assign resources as number of hours each day	■	■	□	■	■	■
Can assign resources to work on particular days in a task's duration	■	□	■	□	■	□
Can assign the same resource more than once to a task	■	□	■	■	■	■
Can schedule the production and consumption of material resources	■	■	□	□	□	■
Assignment priorities	■	□	□	■	□	□
Can keep notes on resources	■	■	■	□	□	□
Independent projects can be merged together and split apart maintaining link effects	■	■	■	□	■	□
Can maintain links between independent projects not in the same file	■	□	■	□	■	□
Links can be made at the task level	■	■	■	□	■	□
Number of independent projects that can be linked together	Unlimited	Unlimited	20	Unlimited	Unlimited	None
Can produce multiproject PERT from independent projects	■	■	□	■	■	□
Resource leveling						
Automatic resource smoothing	■	■	■	■	□	□
Automatic resource leveling	■	■	■	■	■	□
Leveling within a date range	■	■	■	□	□	□

	PC EDITORS CHOICE Time Line	Time Line for Windows
	■	■
	■	□
	■	□
	■	■
	■	■
	■	□
	Unlimited/60	1,000/1,000
	□	□
	■	■
	□	□
	□	■
	■	□
	Unlimited	N/A
	□	□
	■	■
	□	■
	□	■
	□	□
	□	■
	□	■
	■	■
	□	□
	■	■
	■	■
	Unlimited	Unlimited
	■	■
	■	□
	■	■
	□	□

CONTINUES

stream is an important consideration.

But SureTrak is still missing some basic project management features: It has no interactive, on-screen PERT chart, automatic resource leveling, or true multiproject management. Task durations can't be set for less than a day, and projects are limited to a maximum of 4,000 tasks. Finally, in spite of improvements, the interface remains outdated. These limitations make the product acceptable only in environments where managers tackle relatively small projects with simple resource utilization—one at a time.

SUITABILITY TO TASK

SureTrak Project Scheduler

	POOR	FAIR	GOOD	EXCELLENT
Planning a project	●	●	○	○
Managing a project	●	●	○	○
Communicating about a project	●	●	●	○
Workgroup project management	●	○	○	○

PROJECT INTERFACE

SureTrak's main work area is its Gantt chart. However, to get there, you must work your way through no fewer than three full-screen menus. On the other hand, once you're there, the Gantt chart does offer speed keys that let you jump to a number of report areas or menus.

Other aspects of SureTrak's interface work better. Single keystroke commands and fully integrated mouse support make it easy to operate the program. You can enter a number of data items, such as codes, dates, and predecessors, by picking them from a list in a pop-up box. SureTrak also has a quick-add feature for recording new activities. You can change task durations with the plus and minus keys, and use the F1 key to access extensive on-line help.

PRIMITIVE ON-SCREEN GRAPHICS

The task bars in the Gantt chart exemplify the worst aspects of the program's old-fashioned design style. Noncritical tasks are represented by a single line with dots for slack; hammock activities use the close-bracket symbol as a fill pattern. Clearly, these display symbols were the inspiration of a programmer, not a graphic artist. You can change menu, text, and background colors, but your customization options end there.

When you add tasks to a project in the Gantt chart screen, you work in a series of pop-up forms for predecessors, successors, resources, costs, and dates. SureTrak's three extra code fields let you view or analyze a project by criteria such as project phases, subcontractors, and who is responsible for tasks.

You get the standard means for defining task relationships: finish-to-start, start-to-start, and finish-to-finish dependency links; lead and lag times, and total and free float (slack). Among the features missing from SureTrak are task priorities, effort-driven scheduling, and notes, as well as the ability to split tasks. Without these, you won't be able to create finely tuned schedules that could help you shorten a project's critical path.

With SureTrak Project Scheduler you can filter a Gantt chart by picking its phase code and then selecting a date range. The dates can be filled in automatically from a pop-up calendar.

UNUSUAL RESOURCE FEATURES

One impressive SureTrak resource management feature lets you record income-producing resources, and then specify payment and billing patterns to precisely model project cash flow. The cash-flow functions will also let you define the lag time for cost accrual, commitment, approval, and payment. In this way, tasks will have associated costs based on labor, and revenues based on work completed—such as *x* number of dollars for every minute of a commercial being developed in a project run by a video com-

SUMMARY OF FEATURES

Products listed in alphabetical order ■ = YES □ = NO	CA-SuperProject for Windows	InstaPlan EMS	Microsoft Project 3.0 for Windows (PC Editors' Choice)	Project Director	Project Scheduler 5	SureTrak Project Scheduler
Resource leveling (continued)						
Leveling can split assignments/tasks	■	■	□	□	□	□
Cross-project resource leveling	■	■	■	■	■	□
Number of projects	Unlimited	Unlimited	20	8	Unlimited	N/A
Can exclude specific projects from leveling	■	■	■	■	■	□
Can highlight or list overallocated resources	■	■	■	■	■	■
Can create resource histograms representing cross-project allocations	■	■	■	■	■	■
Can maintain subprojects	■	■	■	□	■	□
Costs						
Can specify various cost rates by date for individual resource	■	□	■	□	□	■
Number of cost rates	16,000	N/A	Unlimited	N/A	N/A	2
Overtime cost rates	■	□	■	■	□	■
Cost codes	■	■	■	□	■	■
Tracking						
Percent complete:						
By time	■	□	■	■	■	■
By work	■	■	■	■	□	■
By achievement	■	□	■	□	□	■
By cost	■	■	□	□	□	■
Actual start dates	■	■	■	■	■	■
Actual finish dates	■	■	■	■	■	■
Actual resource use	■	■	■	■	■	■
Actual dollars spent	■	■	■	■	■	■
Fields for:						
Remaining duration	■	□	■	□	■	■
Remaining resources	■	■	■	□	□	■
Remaining cost	■	■	■	□	□	■
Late starting tasks can be automatically set to start at an as-of date	■	□	■	■	■	■
Assisted updates	■	□	■	□	□	■
Reporting and printing						
PostScript support	■	■	■	■	■	■
PCL 5 support	■	■	■	■	□	■
Plotter support	■	■	■	■	■	■
Number of text report/graphics report types	17/21	4/3	Unlimited/ Unlimited	16/5	9/5	10/5
Cross-tabulated reports	■	□	■	□	■	■
Resource allocation report	■	■	■	■	■	■
Cost distribution report	■	■	■	■	■	■
Variance reports	■	■	■	■	■	■
Status report for each resource by task	■	■	■	■	■	■
Earned value report	■	■	■	□	□	■
C/SCSC reports with BCWS, BCWP, and ACWP	■	■	■	□	□	■
Control over column width	□	■	■	■	□	□

N/A—Not applicable The product does not have this feature

	Time Line	Time Line for Windows
	■	□
	■	□
	Unlimited	N/A
	■	□
	■	■
	■	■
	■	■
	■	□
	Unlimited	N/A
	□	□
	■	■
	■	■
	■	■
	■	■
	■	■
	■	■
	■	□
	■	□
	■	■
	■	■
	■	■
	■	■
	■	■
	■	■
	■	■
	■	■
	16/3	3/5
	■	■
	■	■
	■	■
	■	■
	■	□
	■	■
	■	■
	■	■

CONTINUES

FACT FILE

SureTrak Project Scheduler, Version 2.0

Primavera Systems Inc. (SureTrak Division), 1574 W. 1700 South, Salt Lake City, UT 84104; 801-973-9610; fax 801-973-9725

List Price: $795
Requires: 640K RAM, DOS 3.3 or later
In Short: A second-generation make-over of a 1983 project management program, SureTrak still shows the signs of its origins—its unrefined screen graphics and old-style command structure. More important, it lacks an interactive on-screen PERT chart, automatic resource leveling, task durations of less than a day, and sophisticated modeling features. On the plus side are its ability to record project revenues, manage cash flow, and produce stunning output graphics.

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pany. SureTrak Project Scheduler's cash-flow features are ideal in situations where time or products are billed to clients during, or even after, a project. This would also apply to companies whose divisions, such as research and development, act as profit centers.

Otherwise, SureTrak's resource management facilities are weak. You define resources with a daily work limit in hours, and a unit cost. A resource can be allocated in hours by day, week, or month. SureTrak doesn't let you split resource assignments, record specific resource workdays or holidays, and, most important, it can't automatically level resources. There are aids for manual leveling, but even with them, it can be a tedious process. You have to decide which tasks to delay, and then possibly reassign resources, add resources, or change their availability. As you make changes, other resources can become overallocated. If you have a project with dozens of resources and more than a few are overallocated, SureTrak Project Scheduler may take quite a few iterations before the schedule is properly leveled.

STUNTED SPEED

Frequent revisions are inherent to project planning, and SureTrak's slow calculation hurts you here. The program came in at the bottom of the pack on PC Labs' schedule recalculation test. It took over 10 seconds to recalculate our test project, compared with less than a second for the fastest program. On the other hand, SureTrak had the fastest project load time and came in a close second on saving the project file.

Updating your schedule in SureTrak reveals another shortcoming. The program uses percent complete and the planned start date to calculate remaining duration. You can enter a percent complete figure on your own, or a different start date, but then you have to make the other calculations by hand. This type of manual approach is unacceptable project management today. Resource and cost updates can be controlled by percent complete or by entering actuals, which will automatically calculate the remaining amount. The ability to track actual resource use and to compute variances between the planned amounts and actuals is new in this version of SureTrak Project Scheduler. Without these functions, the tracking features would be of very little value.

GOOD REPORTS

SureTrak's reporting facilities let you produce presentation quality output. You get both a text and graphical report writer built in. The graphical reporting capability shines most of all. Working in a WYSIWYG mode, you can change colors, add symbols and logos from a symbol library, and draw boxes, circles, and polygons. You can place text anywhere, size it, and orient it in any direction. A zoom function lets you enlarge any portion of the chart for viewing or printing. You can cut, copy and paste, and overlay one graphic on top of another—the possibilities can almost overwhelm you, and the results are top-notch.

SureTrak Project Scheduler 2.0's screens make its early origins painfully clear, and its standard project management functionality lags far behind the other packages reviewed here. It's hard to imagine spending $795 for this package. If you absolutely need the cash-flow management features it now includes, you might want to consider it. Otherwise, look elsewhere.

▶ SUMMARY OF FEATURES

Products listed in alphabetical order ■ = YES □ = NO	CA-SuperProject for Windows	InstaPlan EMS	Microsoft Project 3.0 for Windows (PC Editors' Choice)	Project Director	Project Scheduler 5	SureTrak Project Scheduler
Reporting and printing (continued)						
Margin control	□	■	■	■	□	■
Control over page length	■	■	■	□	■	■
Adjustable page breaks	■	□	■	□	□	■
Reports can be forced to one page	■	□	■	■	□	■
Size of reports can be scaled	■	■	□	■	■	■
Font control	■	□	■	■	■	■
Mix fonts on one page	□	□	■	□	■	□
Customizable legend	□	□	■	□	□	□
Graphical page preview (WYSIWYG)	■	■	■	■	□	■
Can display multiple pages at once	□	□	■	■	□	□
Maximum number of pages	N/A	N/A	32	Unlimited	N/A	N/A
File import/export:						
ASCII	■	■	■	■	■	■
DBF	■	□	■	□	■	■
WK1	■	□	■	□	■	■
XLS	■	□	■	□	□	□
Import selected records only	■	■	■	□	■	■
Import or export to other PM programs	□	□	■	■	■	■
Other programs	N/A	N/A	Open Plan, Primavera Project Planner, ViewPoint	Any that read ASCII	Artemis	Finest Hour, Primavera Project Planner
Networking						
Network version or LAN pack available	■	■	■	□	■	□
File locking	■	□	■	□	■	□
Query while file is locked	■	□	■	□	■	□
Password protection by project	■	□	■	□	■	□
Multilevel password protection	■	□	□	□	■	□

N/A—Not applicable: The product does not have this feature

Symantec Corp.

Time Line

Although it lacks the refined interface of its Windows sibling, Symantec Corp.'s Time Line 5.0 is an excellent product. It gives you flexible control over data layouts, does a great job of scheduling projects, provides thorough tracking features, and produces superior graphical output. This latest version has also overcome earlier versions' resource management weaknesses. The depth and richness of its features make the $699 Time Line 5.0 the best character-based product available. Its display graphics, however, are unsophisticated, and thanks to an enriched feature set, Time Line has also become harder to learn and use than earlier versions. The result? A package that's best for full-time planners of complex projects, not occasional managers of relatively simple projects.

The program's command structure employs Lotus 1-2-3–style menus plus numerous shortcut keys. Time Line has thoroughly integrated mouse support and scroll bars. You enter data through a logical array of pop-up forms, but they seem to get in the way as you jump from one to another. In adding a resource, for example, you have to go through six different list boxes and forms—and you never do see a list of resources that also shows availability and cost data.

CUSTOMIZE YOUR DATA LAYOUTS

Time Line's main data entry workspace is a Gantt chart with a spreadsheet area on the left where you enter tasks in outline form. You can display up to 16 columns at once, selecting data from a wide range of project information.

Customized layouts and filters are among the program's strongest features. Time Line lets you set up and save spreadsheet layouts with columns and data types arranged to tailor your data view to suit the work you're doing. You might, for example, create a layout dedicated to cost data, which shows budgeted and actual cost information along with several columns devoted to cost variance calcula-

	PC EDITORS' CHOICE Time Line	Time Line for Windows
	■	■
	■	■
	■	□
	■	■
	■	■
	□	■
	□	■
	■	□
	■	■
	■	■
	Unlimited	Unlimited
	■	■
	■	□
	■	■
	■	■
	□	■
	■	■
	Artemis, Open Plan, Primavera Project Planner	Microsoft Project for Windows, On Target, Time Line
	■	■
	■	■
	■	■
	□	□
	□	□
		ENDS

tions. Layouts are saved to a pop-up list box, so you can access them and move between views quickly.

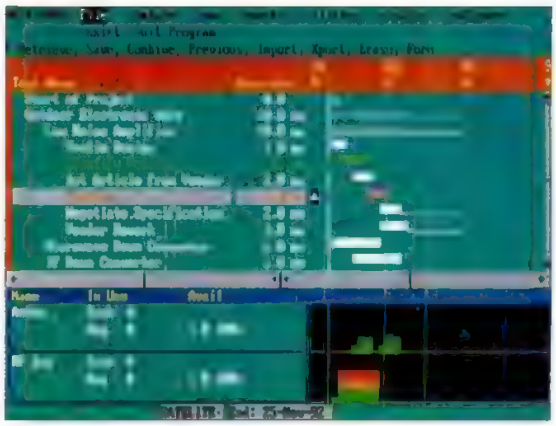
You can customize your data views further by using selection or highlight filters with your layouts. Filters let you focus your attention on related tasks and report specific project information. For example, you might decide to filter out everything but the first two weeks of a project, highlight project milestones, or see only those tasks that use specific resources. Filters can have multiple criteria and use quantitative expressions, such as "greater than" or "equal to." The program comes with a library of filters, and you can define your own and save them to the pop-up filter list.

SUITABILITY TO TASK

Time Line

	POOR	FAIR	GOOD	EXCELLENT
Planning a project	●	●	●	●
Managing a project	●	●	●	○
Communicating about a project	●	●	●	○
Workgroup project management	●	●	●	○

Time Line also lets you set colors for text, menus, and other items. Unfortunately, you can't control the display style of the Gantt bars, PERT boxes, or other graphical elements. Gantt chart bars for critical and noncritical tasks look too much alike (although you can highlight critical tasks by color, using a filter). Also, the PERT chart uses only vertical and horizontal connecting lines, making it hard to read complex or large projects.



Time Line 5.0's color capabilities approach those of Microsoft Windows-based programs. You can display up to five resource histograms at the bottom of the Gantt Chart.

PROJECT STRUCTURE

The program's scheduling features let you build precise project models for outstanding schedule control. You can record task durations down to the minute, use effort-driven scheduling to control task durations by the number of resources assigned, enter fixed tasks by a must-start, no-sooner-than, or no-later-than date (the latter two choices are new to Version 5.0), use WBS and OBS codes to filter tasks by level in the outline or by resource group, assign task priorities, or set any of the standard dependency types.

Also new to 5.0 is the ability to split tasks so they stop and start according to resource availability. Time Line also lets resources get a head start on tasks if they become available sooner than originally planned. If the effort expended on a task is out of sync with its duration, the Spent time and To Go times can be tracked separately, making a schedule more accurate. As proof of this, Time Line produced the second-tightest schedule in PC Labs' resource-leveling tests—tied with Microsoft Project.

RESOURCE MANAGEMENT ADVANCE

Time Line 5.0 represents a major step forward in resource management. Now you can vary resource availability by amount, percentage, and date. If, for example, you have a group of eight scientists working at 100 percent when a research project begins, you could drop that availability to five working at 50 percent a month later. You can make as many as 300 such changes per resource. This feature also lets you introduce efficiency factors into your scheduling by specifying that an individual can work at less than 100 percent of capacity. New resource calendars help you refine availability even further. Cost rates for an individual resource can also vary.

Time Line's automatic resource leveling can exclude specific resources or work within available slack without pushing the end date. You can display histograms of up to five resources at once, which is

PC EDITORS' CHOICE — FACT FILE

Time Line, Version 5.0

Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; 800-441-7234, 408-252-3570; fax 408-255-3344

List Price: $699, upgrade from previous version, $179
Requires: 640K RAM, DOS 3.1 or later.
In Short: Time Line 5.0 offers excellent scheduling features and has now added a number of resource management features missing in earlier versions. You can save data layouts and filters that let you tie your data views to the work you're doing. You can also track projects with great accuracy and produce presentation-quality graphics output. On the other hand, the program's interface is still caught in the limitations of its character-based environment. It's one of the more difficult PM programs to learn.

473 ON READER SERVICE CARD

Frame Maker. Windows pub

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Full-speed WYSIWYG word processor boasts a powerful spelling and hyphenation dictionary.

Graphics capabilities include a full set of drawing tools and support for 24-bit color images.

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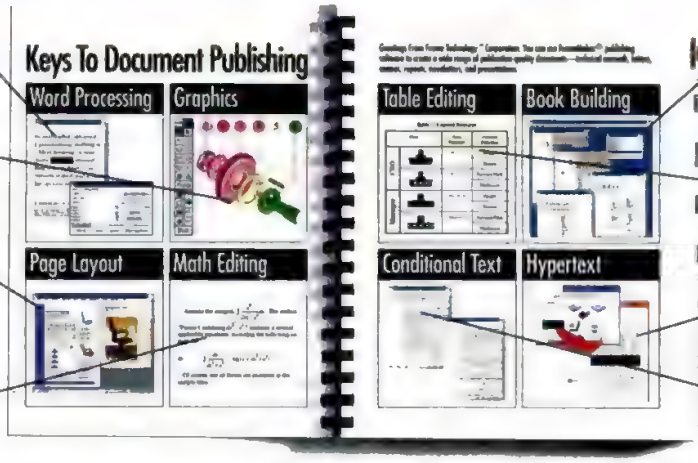
Sophisticated mathematics editor handles everything from simple arithmetic to calculus.



FrameMaker's book building tools allow automatic multichapter cross-referencing, plus multiple indices and tables of contents.

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—Steve Ballard, Intel Corporation

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CIRCLE 103 ON READER SERVICE CARD

great for looking at how well related resources are being utilized in the project. Multiple histograms also make it easier for you to do manual leveling and gain better control over how conflicts are resolved. The only way to add or increase the availability of resources to a task is to level manually.

Time Line's automatic leveling routine is the fastest of all the programs we tested in this review. However, in the other areas, the program was comparatively slow. For example, its result on recalculating the schedule, 7 seconds, was the second slowest.

TRACK-ABILITY

Time Line offers a complete feature set for progress tracking. You can enter actual effort expended and dollars spent and estimate the work accomplished. Achievement figures for summary tasks are calculated with one of several weighting methods.

Reports also help you track progress. The program has 14 text report types, so you can report on virtually any data. Time Line's graphical reports are presentation-quality. You can control border thickness, task bar and box styles, color, the placement of titles, legends, and other text, but you get only one typeface at one size. A useful report feature lets you specify that a chart print on a single page regardless of its size. You can control the size of charts in two other ways: by forcing them to print on a fixed number of pages across or down, or by setting a percentage of the original size to reduce or enlarge the output. A preview mode shows you exactly how the chart will print.

Despite the limitations imposed by its character-based nature, Time Line 5.0 is an excellent product. It allows you to build precise, refined schedules, offers flexible data entry, and now has sophisticated resource management. But you'll have to pay for Time Line 5.0's accomplishments in learning time and the limitations of its interface.

SUITABILITY TO TASK
Time Line for Windows

	POOR	FAIR	GOOD	EXCELLENT
Planning a project	●	●	●	○
Managing a project	●	●	●	○
Communicating about a project	●	●	●	○
Workgroup project management	●	●	●	○

Symantec Corp.

Time Line For Windows

To create Time Line for Windows 1.0, Symantec Corp. did *not* take the DOS version of the product and customize it for the Windows environment. Instead, Symantec seems to have taken the interface from On Target, its Windows-based project planning package for general managers, and enhanced it.

Make no mistake, Time Line for Windows is unquestionably an intelligently designed mainstream project management product. However, some of the more recent and important additions to Time Line 5.0—such as

You Can Look

9065s

T560i

T660i

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task splitting during resource leveling, and variable resource assignments—have been left out of this $699 Windows package.

Time Line for Windows' elegant and simple interface helps make it easy to learn and use. Unlike packages that overwhelm you with project-view choices, Time Line for Windows starts with a manageable few and lets you customize and save views as you wish. Further, its screens and menus are uncluttered, dedicated task buttons perform many common functions, and you can readily customize the displays.

You encounter Time Line for Windows' admirable design at the first screen, where you're presented with a Quick Start dialog box that lets you choose between loading the last project you worked on, picking another, starting a new one, or using one of the program's ten starter schedules. (A starter schedule gives you a ready-made framework for building a project plan.)

THREE WAYS TO SEE

Time Line for Windows offers three main views for creating a project: a Gantt chart, a PERT chart, and a resource spreadsheet. The Gantt view is the primary work screen. Split into two window panes, the left side holds a spreadsheet and the right side contains the Gantt chart. The spreadsheet can display up to 26 data columns at once, selected from 180 fields. This gives you a bird's-eye view of your project and lets you focus in on the details of costs and progress. Spreadsheet size is controlled by dragging a pane divider. The spreadsheet is task-centered, and uses an outline motif to create automatic summarization.

The Gantt view is the cleanest of any of the Windows-based programs we reviewed. Once inside it, you change start dates and durations by dragging the task bars, and set task dependencies by dragging link lines between bars. This chart can be replaced with a cross-tabulated view that lets you see resource effort or task costs distributed under a time scale. The latter is a great way to see a lot of in-

FACT FILE

Time Line for Windows, Version 1.0

Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; 800-441-7234, 408-252-3570; fax 408-255-3344

List Price: $699, migration from Time Line 5.0, $179, migration from On Target, $199, upgrade from any other project manager, $199
Requires: 2MB RAM, DOS 3.1 or later, Microsoft Windows 3.0 or later
In Short: Time Line for Windows gives you solid control over the appearance of charts and text and lets you freely customize project views. You can save these views and use them in other projects. The package makes extensive use of dedicated task buttons, its screens are uncluttered, and its command structure is simple and straightforward. As a result, you can learn the program quickly. However, you won't find all the sophisticated modeling features contained in Time Line 5.0. When these are added, the program should be nearly unbeatable

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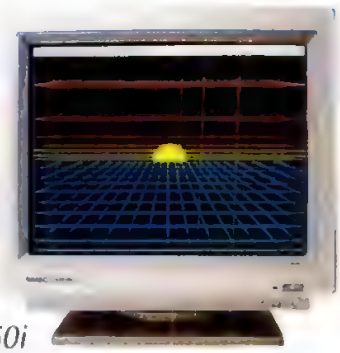

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formation at once.

The PERT chart window presents a work-flow view of your project with individual task boxes inside outline boxes. The outline PERT is a nice organizing device unique to Symantec products, but it's hard to follow all of the intersecting lines in complex projects. You can create tasks here, enter information directly in the task box fields, draw dependencies, and drag task boxes around. A handy zoom button on the toolbar lets you enlarge or reduce the view of your PERT network.

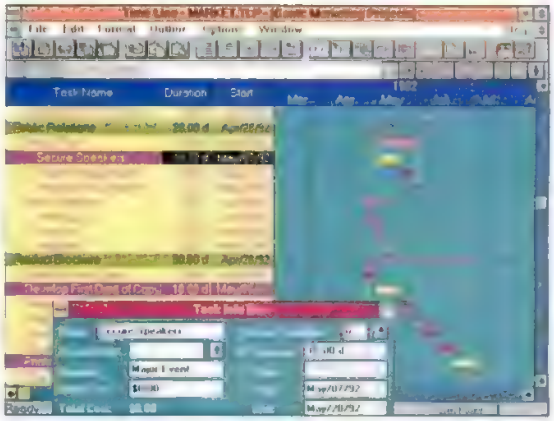
In the resource spreadsheet, you can enter and view your general resource information. If you tile this window with the Gantt chart window, you can drag a connection between resources and tasks to make assignments. This process is wonderfully intuitive.

In addition to the primary views, you can create customized views and jump between them to work on different aspects of the project. You can save a customized view as a library file and load it into any schedule. TL for Windows also lets you add colors to the screens and change fonts for headings and text. You can use a different color and font for a highlight filter, and even specify different colors and fonts for tasks.

OPERATIONAL EASE

Symantec has kept Time Line for Windows' menus simple, and many operations can be performed using the 32 colorful iconized task buttons on the toolbar. For example, buttons are provided for changing the outline; cutting, copying, or pasting; marking tasks complete; or opening dialog boxes for task, timing, note, or assignment information. Since the information dialog box is small, you can leave it open while you work in the Gantt or PERT charts without its obscuring your view of the chart.

Another special resource, Co-Pilot, pops up a dialog box whenever you perform an action that may seem ambiguous. If, for example, you drag a task bar to a new position, Co-Pilot asks if you want to set a dependency or a fixed start date.



Time Line for Windows gives you excellent control over a wide array of colors and typefaces, plus icon buttons for performing many operations.

TOOLS

Time Line for Windows offers solid, if unexceptional project management tools. You can schedule up to 8,000 tasks in a project, indicate durations down to one-tenth of an hour, use ASAP, ALAP, or

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simple fixed-date task types, and employ effort-driven scheduling. Projects can utilize up to 1,000 resources, defined by a default assignment value, maximum availability, a standard work week, a resource calendar, and cost rate.

As noted, however, Time Line for Windows is missing a few of the more sophisticated project management tools. You can't apply varying resource availability or cost rates, or assign resources to begin work early or to work at specified hours. Time Line for Windows' tracking facilities center around actual dates and percent complete. Yet the product's progenitor, Time Line 5.0, uses an approach that lets you track percent complete, actual dates, and actual hours spent. TL 5.0 also produces many more text-based reports—particularly in the cost area—giving you a better feel for a project's progress. But Time Line for Windows produces more graphical reports, which makes it better at visual communication.

On PC Labs' resource-leveling test, the program produced a schedule that was almost a month longer than the best result. Its leveling speed was second best, however, only a little behind Time Line 5.0. Project schedule recalculation was faster than average, but the package slowed down considerably on the project-load and project-save tests.

Time Line for Windows lacks the depth of features of its DOS-based sibling.

CHOICES

Symantec offers another Windows-based project planner, On Target (which requires 1MB of RAM, DOS 3.0 or later, and Windows 3.0 or later). It has almost exactly the same interface, menu structure, and commands as Time Line for Windows, although some menu items appear in different places. On Target, however, is designed for general managers, not professional project planners. It uses more generic terminology for some project management tools—Work Flow instead of PERT chart, for example—which makes its features more accessible to people without PM experience.

In On Target's default setting, you enter only who's responsible for a task rather than assigning resources. If you choose the resource assignment option, however, you get nearly the same functionality as in Time Line for Windows. Some of the more important elements left out of this program are effort-driven scheduling, many of the dedicated task buttons, and multiproject consolidation. The program is also restricted to about 2,500 tasks. For people who don't need the full panoply of PM features, this $399 product is a worthwhile choice.

As a translation from Time Line in the DOS world, Time Line for Windows feels incomplete. The interface and ease-of-use features are splendid, but the depth of features that makes Time Line 5.0 so good is disappointingly absent. □

HENRY FERSKO-WEISS IS A COMPUTER CONSULTANT AND A FREQUENT CONTRIBUTOR TO PC MAGAZINE.

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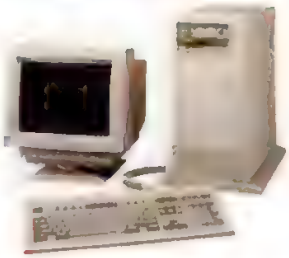

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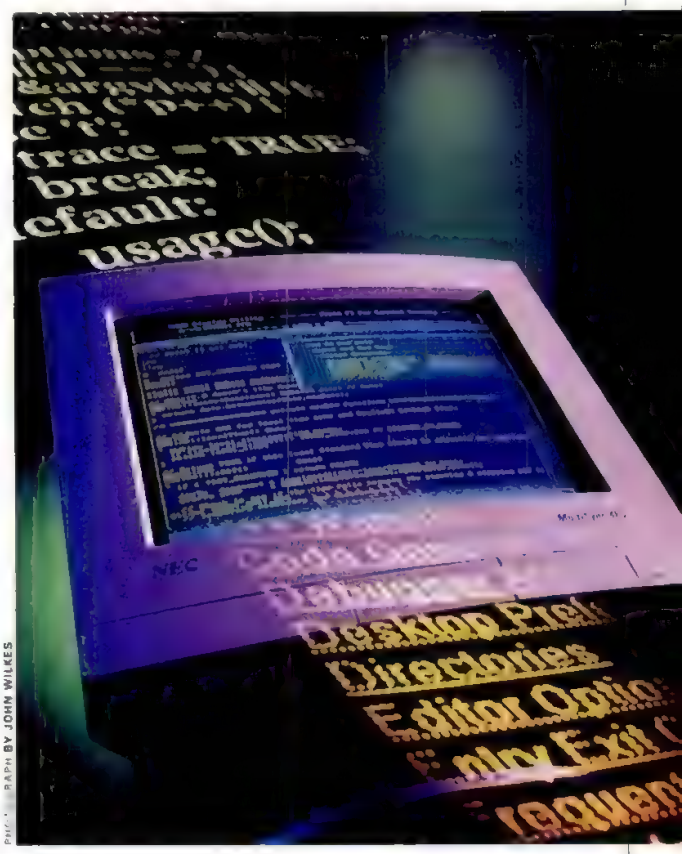


PHOTOGRAPH BY JOHN WILKES

C/C++ programming—once the exclusive domain of leading-edge programmers—has now gained a huge acceptance in mainstream environments. Part of the reason is that the C language and its object-oriented C++ superset are well suited to creating large, fast-executing applications with highly portable code. But another reason for the lure of these packages is that they have grown from being solely compilers to being complete applications development environments.

IN THIS REVIEW

376 Borland C++ with Application Frameworks
387 Microsoft C/C++
392 TopSpeed C/C++
399 Zortech C++

by Sheryl Canter

In addition to containing compilers, the part of the program that translates source code into binary code executable by the computer, these packages are one-box development systems. Each of the packages reviewed here uses an IDE (Integrated Development Environment), which is a shell that integrates a wide range of programming tools.

In addition to the compiler, the IDE gives you access to the linker, which brings pieces of compiled code together into an executable file; the debugger, which lets you step through your program as it executes to help locate errors; and the editor, which is the programmer's word processor. Often an IDE will provide extensive on-line help for language syntax and the ability to launch other tools such as a profiler, which tells you which parts of your program are taking longest to run.

From the beginning, entry-level C compilers used simple IDEs to make life easier for novice programmers; however, the idea appealed to professional programmers as well. Slowly, the IDE was introduced into professional C compilers. When IDEs were restricted to real mode, professional developers were forced to use the command line version of the compiler because their programs were often too big to run within the IDE. This is no longer the case: The programs run either in extended mode (such as Microsoft C/C++) or have the option of running in either real mode or extended mode. For TopSpeed C/C++, the extended environment is an add-on option.

AUTOMATING MAKE FILES

Another important feature of an IDE for professional development is the project MAKE facility, which automates the process of specifying how the myriad components of a program fit together. Without an automatic MAKE facility, you have to write the MAKE file yourself. Not only do you have to know the MAKE file syntax, you have to know all of the correct command line compiler and linker switches.

Since IDEs let you choose compiler and linker options from menus, you shouldn't have to specify these options when writing multifile programs. Some packages are more advanced than others. Borland C++ and Microsoft C/C++ take care of project management automatically; you need to list only the component files. TopSpeed takes a bit more work. You must carefully design your header files, but it will then configure the elements automatically, without requiring you to list the component files. Unfortunately, Zortech C++ provides virtually no automatic project MAKE facility.

THE MOVE TOWARD C++

The other most compelling development on the C compiler front is the incorporation of C++ into the C environment. C++ is a superset of C that was designed to facilitate object-oriented programming (see the sidebar "Object-Oriented Programming").

Object-oriented programming (OOP) is designed to let developers program in a more conceptual style. C++'s virtual and overloaded functions let you name actions in the abstract, rather than requiring that you specify a different function name for each variant in a program. For example, you can use the same *DrawObject* function to draw a circle or a square, or one function name can be used to perform numerical operations on both floating-point numbers and integers.

Because of OOP's importance in the programming world, we have restricted our reviews to C/C++ compilers. We have further restricted our evaluations to those that can produce 16-bit code, since there are still so many computers in programmers' homes and on office desktops with 16-bit processors (see the sidebar "32-bit C/C++ Compilers").

CLASS LIBRARIES

C itself is actually a rather small language with much of the basic functionality—even the print facilities—housed in the

Suitability to Task: C/C++ Compilers

C/C++ compilers should provide a convenient working environment with the tools necessary to write, compile, link, test, and debug applications. Full-featured packages offer a greater degree of control over all facets of the development process.

SUITABILITY TO TASK

Product Name	POOR	FAIR	GOOD	EXCELLENT
Small DOS applications	●	○	○	○
Large DOS applications	●	●	○	○
Windows applications	●	●	●	○
C++ development	●	●	●	●
Portability	●	●	●	●

The **small DOS applications** test evaluates the ease with which a new C or C++ programmer can navigate the development cycle. The quality and completeness of the menu-driven environment are important considerations, and better ratings are given to those packages that offer a full-featured text editor, useful utilities, integrated source-level debugging, quick compilation, context-sensitive on-line help and sample program files.

Developing **large DOS applications** requires manipulation of multiple source files, so project MAKE facilities are important. Quick compilation is also important. Optimization should be available for reducing the size or execution time of an executable, but the user should also be able to switch off optimization as desired

Windows applications packages should have Windows-specific programming tools such as a debugger, profiler, class browser and user interface library in addition to the basic requirements for the creation of a Windows application. Well-constructed packages will include a resource editor along with the resource compiler, and provide on-line information on the SDK from within the IDE

With **C++ development,** one of the most important considerations is how fully the C++ language is implemented. The best C++ compilers comply with the AT&T Version 2.1 standard and implement at least part of the Version 3.0 standard—for example, templates. A class browser should be included, as should special facilities for debugging C++ programs such as the ability to watch, inspect, and change fields within objects. C++ runtime libraries are a useful addition.

Portability rates the degree to which a package can be used to compile code on different platforms. Conformance with language standards and support for multiple operating environments such as DOS, OS/2, or Unix are important components DOS packages should work with standard DOS extenders; the better packages will include their own DOS extender.

standard runtime library. (A library is a special kind of canned compiled code that you can link into your program and use.) Until recently, the only libraries included with a compiler were the standard runtime library and a graphics library. If you wanted other libraries, you bought them from third-party suppliers. Today's compilers routinely include all sorts of libraries that extend the language in various ways to make programming easier.

Part of the reason for this welcome profusion of add-on libraries can be attributed to the emergence of C++. C++ class libraries take advantage of virtual functions, making them more configurable and flexible than standard C libraries.

Borland C++ and Microsoft C/C++ have clearly taken the lead in making user-interface libraries a large component of their packages. Borland C++'s optional Application Frameworks class libraries aid in user interface development under both DOS and Windows. Microsoft C/C++ includes the Foundation Classes, a set of user interface libraries for Windows.

EDITORS' CHOICE

• Borland C++ with Application Frameworks

The $749 Borland C++ with Application Frameworks has a powerful yet user-friendly IDE and outstanding development tools. Compilation times are quick, and the resulting executables are respectable in size and speed. For all of these reasons, Borland C++ receives our Editors' Choice.

Microsoft C/C++ offers good but not quite top-notch features. The IDE is user-friendly with excellent on-line help, but it's slow, and the debugger isn't fully integrated. There is a resource editor, but it's not as good as Borland's Resource Workshop. Also, Microsoft C/C++ forces you to use 386MAX as your memory manager.

Zortech C++ stands out for its broad, cross-platform support, 16- or 32-bit code generation, and IEEE floating-point standard compliance, but its lack of a project MAKE facility is a serious drawback.

TopSpeed C/C++ is notable for its exceptional linker, which outputs executables smaller than all others, and for its unusual open-architecture development environment. However, the IDE needs an overhaul, especially in the area of mouse support.

We didn't award an Editors' Choice for entry-level compilers since we feel that full-featured products are the better way to go; you will outgrow all of the entry-level products quickly. But our evaluation showed that Borland's Turbo C++ (for both DOS and Windows) is a better buy than Microsoft's QuickC. Turbo C++ is not only less expensive, but more powerful and fully featured.

WINDOWS PROGRAMMING

Developing a Windows application is not an easy task. There are more than 1,000 functions in the Windows 3.1 Software Development Kit (SDK), a library of functions callable from C or C++. Frankly, anything that can make the task easier is welcome.

Certainly, Borland C++ and Microsoft C/C++ have the most extensive tools for developing Windows applications. Until Borland International released Borland C++, Version 2.0, the only way you could hook your program into Windows was to purchase the Windows SDK.

Today, Borland C++ 3.0 continues to provide a self-contained substitute for the Windows SDK with full support for the Windows 3.0 API (Application Program Interface). Borland C++ 3.1, which will be available by press time, will provide support for the Windows 3.1 API. Microsoft C/C++ comes with the complete Windows 3.1 SDK. Zortech C++ is bundled with the Windows 3.0 SDK. For TopSpeed C/C++, the SDK must be purchased separately if you want to do Windows programming.

In addition, the packages may include things such as class libraries, class browsers, resource editors, and access to help with the Windows SDK through the IDE in order to make the task less daunting. When choosing a package, it's important to look for these extras.

As for developing Windows programs while in the Windows environment, currently, the only Windows-hosted IDE is found in Borland's entry-level compiler, Turbo C++ (which, incidentally is included with Borland C++). Borland C++ 3.1 will also include a professional-level, fully optimizing compiler with a Windows-hosted IDE.

THE HEART OF THE MATTER

Despite the importance of the trimmings—the development environment and all of the various programming tools—you're still basically buying a compiler. When it comes to the extras of the development system, the larger companies like Microsoft and Borland do it best, providing plenty of supplemental features that make life easier. The strengths of the smaller companies come to the forefront when looking at the compiler itself.

Zortech C++ is the only compiler that can run in either 16- or 32-bit mode via a simple switch. Zortech C++ also supports the most operating environments: DOS, Windows, OS/2, and Xenix. And not only is it compatible with third-party DOS extenders, it provides a very fast DOS extender of its own. Furthermore, it is the only C compiler to implement the IEEE floating-point standard and extensions.

TopSpeed C/C++ has a technologically superior linker that can eliminate unnecessary static variables and virtual functions. The result is the smallest exe-

Our Contributors: SHERYL CANTER is an associate editor of *PC Magazine*. CHARLES PETZOLD and RICHARD HALE SHAW are contributing editors to *PC Magazine*. BEN MYERS is a Boston-based consultant who writes regularly for *PC Magazine*. THOMAS SIERING is a benchmark test developer at Ziff-Davis Labs. RUDYARD MERRIAM is a Houston-based consultant.

Object-Oriented Programming

by Sheryl Canter

C++ is a superset of C designed to facilitate OOP (object-oriented programming). OOP is as big a revolution in the programming world today as structured programming was 20 years ago. It's a whole new way of thinking. Many professional C programmers are just learning about OOP and debating its merits, and it has not yet become the new standard.

Why make the change? What does OOP offer that warrants so much relearning and so much rewriting of existing code?

Its most obvious advantage is with group projects. Ten years ago, PC programs were often one-person projects, but that is rarely the case today. With the skyrocketing power available on the desktop, PC programs that take advantage of that power are generally written by a team of programmers. As programs have gotten larger, debugging and maintaining them has grown exponentially more difficult. Object-oriented programming addresses the problems inherent in debugging and maintaining large, complex programs.

ENCAPSULATION

The term *object-oriented* has become clouded by popular definitions and interpretations. A key feature (but not the only feature) of OOP is that data and the functions that operate on that data are encapsulated into a self-contained object. Visual development environments (reviewed in *PC Magazine*, June 16, 1992) are referred to as object-oriented, but most are object-oriented only in terms of encapsulation. You paint an object on the screen and then describe its characteristics such as its color, its size, and its behavior when you click on it with the mouse.

Encapsulation is accomplished through the use of *classes*. Classes are similar to data structures, but are more than just data structures. They also include the program code *(member functions)* for operating on that data. Just as you can declare instances of a data structure, you can declare instances of a class. Instances of a class are called *objects*. Confusingly, these same concepts go by different names in other object-oriented languages. For example, in Pascal, a class is called an *object*, an object is called an *instance*, and a member function is called a *method*.

Encapsulation provides numerous advantages. Data within a class can be declared *private* and is accessible only within that class. This ensures that only that class's member functions can access the data—a highly useful protection in multiprogrammer projects. With encapsulation, large programs are much more readable because all of the related code and data is in one place. Object-oriented programs are also more modular and therefore more easily maintained.

INHERITANCE

OOP is much more than encapsulation: *Inheritance* and *polymorphism* are crucial pieces of the approach. Inheritance lets you derive new classes that inherit the properties (both data and member functions) of a previously defined class. The new properties are built on top of the inherited properties, which can save programmers quite a bit of coding. *Multiple inheritance* lets you create a new class with properties of more than one previously defined class.

Through inheritance, a hierarchy of classes is created to form the backbone of your program. Designing a useful and elegant class hierarchy is no trivial matter. It is not uncommon to hear C programmers say they've tried C++ and still don't see the advantage. It takes time and experience to see how to define classes effectively; C++ programming takes much more up-front planning.

There's another problem, too. Since the code from parent classes is pulled into the derived classes, it's easy to create huge overhead in your program without even realizing it. *Class browsers* are included with most C++ compilers to help you to keep track of your class structure.

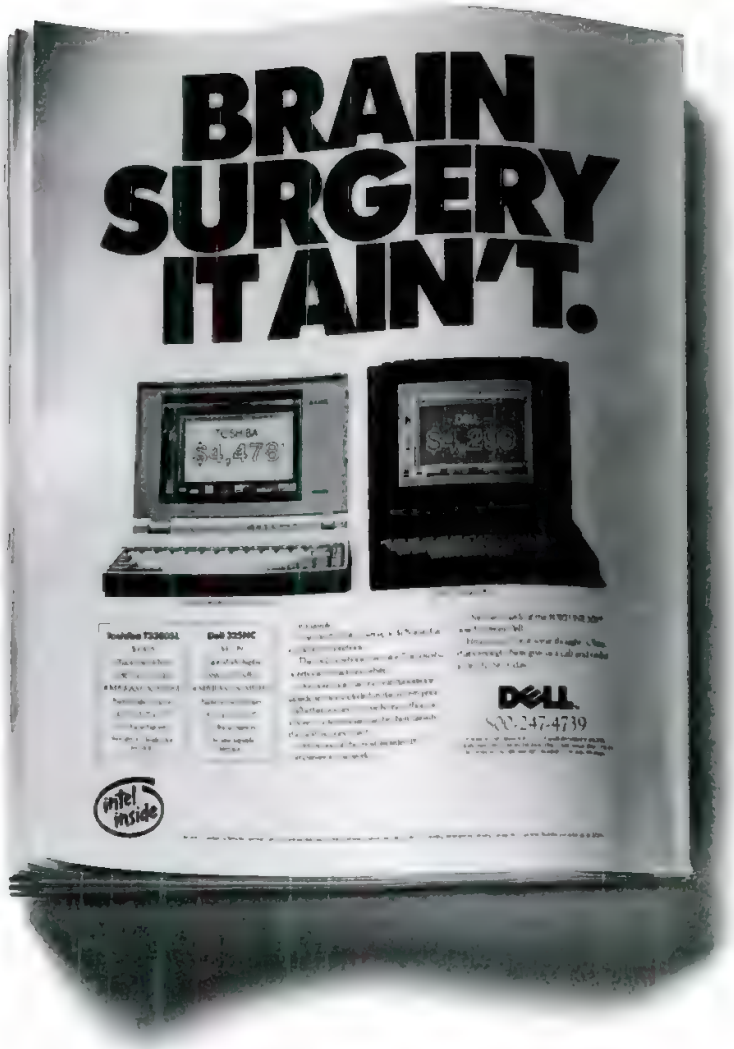
POLYMORPHISM

The third aspect of OOP is *polymorphism*. With polymorphism, the same function or operator (such as a plus sign) can have multiple meanings, depending on the context in which it is used. For example, a plus sign can be *overloaded* to mean concatenation when the operands on either side of it are strings. With functions, polymorphism is achieved either through overloaded functions, where all ambiguities are resolved statically at compile time, or through virtual functions, where ambiguities are resolved dynamically at runtime.

Virtual functions provide C++ with a special kind of extensibility that can be powerfully exploited in class libraries. They can be used as provided, or overridden with customized versions of the functions. This flexibility makes C++ code highly reusable. Programmers do not have to be forever reinventing the wheel just because they want to make one aspect of the code slightly different.

PUTTING IT ALL TOGETHER

The three components of OOP give programmers a vocabulary for describing relationships and processes in abstract terms—the way people really think. For example, the same *OpenWindow* function can be used to open windows for data entry, messages, or any other purpose. OOP is an intriguing new approach to programming. It may feel awkward at first, but you'll enjoy what you can do with it.



YEAH, IT SOUNDS MORE LIKE BRAINWASHING.

Dell Computer must think everyone who's in the market for a 386SX notebook has had a lobotomy. Because they would have you believe you can buy a Dell 325NC with a color screen for less than the price of a Toshiba T3300SL.

It simply ain't so.

At participating Intelligent Electronics dealers, the Toshiba T3300SL sells for $3,165, about $1,300* less than the price Dell quotes in their ad. And even though Dell has recently lowered their prices, they're still $334* higher than Toshiba.

But those aren't the only figures Dell neglected to give you.

The Toshiba weighs 5.9 lbs., while the Dell checks in at a hefty 7.1 lbs. It's also 18% smaller than the Dell. And the Toshiba RAM can be expanded to 18MB, vs. 12MB for the Dell.

As far as color is concerned, Toshiba has several machines that offer brilliant, 256-color TFT active matrix screens, while the best Dell can offer is washed-out passive matrix LCD's.

Actually, in a way, Dell is right. If you want to spend an extra $334* on a bulkier, less capable notebook just to get so-so color, it doesn't take a brain surgeon to figure out that you should buy the Dell.

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*We don't want to mislead you. Since 5/1/92, Dell has lowered the price of the 325NC/80 from $4299 to $3499, and Toshiba has lowered the suggested retail price of the T3300SL/80 (with standard 2MB RAM) from $3999 to $3599. Funny how our price still beats Dell's.

102502

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cutables of any compiler we tested. TopSpeed C/C++ also provides more runtime checking than any other compiler. In addition to the relatively standard check for stack overflow, it supports array-boundary checking, null-pointer dereferencing, and more.

Another important compiler feature is optimization. There are many different types of optimization, but they generally fall into two categories: optimization for size and optimization for speed.

Code optimization is a two-edged sword. When a compiler optimizes your program code, it basically figures out what you're trying to do in your program and then finds a way to do it more efficiently. It's a wonderful concept; you can write your program for readability and let the compiler worry about rearranging it in the way that best suits the hardware. However, there is always the possibility that the optimizer will get it wrong. Some of the worst debugging nightmares result from errors that an optimizer introduces into the code. For this reason, it is reassuring to be able to turn optimization off. Most compilers allow you to do this, wholly or in part. But TopSpeed C/C++ does not.

HOW WE TESTED

Our performance tests look at compile time, executable size, and executable speed in three different scenarios: a quick compilation with no optimization, full optimization for size, and full optimization for speed. We tested these scenarios for three large programs: a C program under DOS, a C++ program under DOS and a C program under Windows.

Our benchmark test programs were actual applications rather than traditional benchmark tests such as Dhrystone, Whetstone, and Sieve. These traditional benchmark test programs artificially test isolated compiler features without considering how they are weighted in real-life applications, so the results can be misleading. We felt that using large, real-life applications in our testing would provide more representative results.

In general, Borland C++ and Zortech C++ led the pack in compile time, especially when optimization was turned on. Microsoft C/C++'s compile times were far slower than those registered by other contenders. TopSpeed C/C++ consistently turned out the very smallest executables—by a mile. Borland C++'s executables tended to be among the largest, except on the C test where Microsoft C/C++ won the booby prize.

In regard to execution speed, Borland C++ performed well on the C test but lagged behind on C++. With Microsoft C/C++ it was just the reverse; the package was the fastest performer on the C++ test (with Zortech C++ running a close second), but ran on the slow side for C. The hands-down winner on C executable speed was Zortech C++.

But benchmark test performance in isolation will not tell the entire story. For example, TopSpeed C/C++ creates executables more slowly because it is doing more complicated things with its linker, hence producing smaller .EXEs. To add to the mixture, while each of the packages offers an integrated development environment, its quality can differ drastically. There are also important differences in the quality and quantity of the programming tools. The reviews that follow reveal the strengths and weaknesses of each product so you can find the one that best meets your programming requirements.

Borland C++ with Application Frameworks

BY THOMAS SIERING

Borland C++ with Application Frameworks has it all: a sophisticated but user-friendly IDE, the fullest implementation of C++, and unmatched Windows development tools. Its especially fast compilation lets you spend more time developing and less time waiting.

With its early entry into the C++ market and its huge installed base, Borland International has probably done more than any other vendor to further the acceptance of C++. Its rapid-fire succession of product releases has kept users and competitors struggling to keep up. The latest Borland offerings include the entry-level compilers Turbo C++ for DOS and Turbo C++ for Windows, and the professional-level compiler Borland

SUITABILITY TO TASK

Borland C++ with Application Frameworks

	POOR	FAIR	GOOD	EXCELLENT
Small DOS applications	●	●	●	●
Large DOS applications	●	●	●	●
Windows applications	●	●	●	●
C++ development	●	●	●	●
Portability	●	●	○	○

C++ with the optional Applications Frameworks, Borland's set of user-interface class libraries. Version 3.1 of the professional compiler is scheduled for release about the time you will be reading this. It will include support for the Windows 3.1 API. In a nutshell, this compiler keeps getting better and better.

STANDARD-SETTING IDE

One of the most popular features of the Borland language products is the IDE. The intuitive interface and context-sensitive help make rushing to the manuals the exception rather than the rule. The integration between the editor and compiler is superb; clicking on an error message takes you directly to the offending statement in the editor.

There is an integrated debugger and a standalone debugger, which is launchable from within the environment but unconnected to the editor. The standalone debugger provides the added features of remote network debugging, dual monitor use, 386 high memory debugging, and hardware debugging. The editor, although not as powerful as a dedicated programmer's editor such as Brief (which, incidentally, is now owned by Borland), is customizable and features macro support.

Borland C++ has an easy-to-use project MAKE facility. You simply select the component files in the file browse window and the IDE automatically generates the information needed. The one inconvenience is that the result is written in a form that can only be understood by the IDE. In order to compile and link from the command line, the project file must be converted into the standard ASCII MAKE file format. Although a conversion utility is provided, it is occasionally plagued by wrong results, forc-

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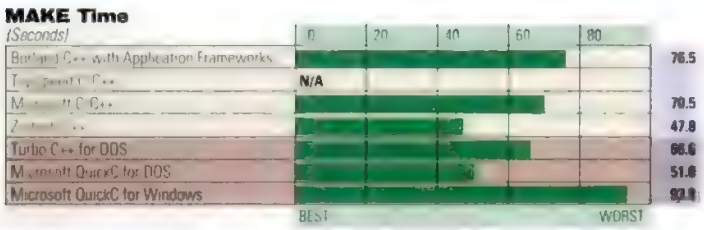
Benchmark Tests: C++ Compilers

Compiler performance varied, depending on what aspect was being tested; there was no across-the-board winner.

C PERFORMANCE

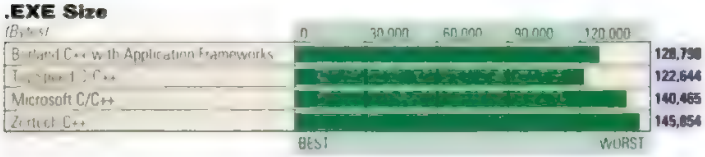
QUICK COMPILE



Execution Time (Seconds)	.EXE Size (Bytes)	Compiler Switches
125	135 102	-A -H=xs_bc sym -v
N/A	N/A	N/A
176	177,953	/f /Od /Yu /Gs /Za /AL
115	147 808	None
123	151 740	IDE default
189	190 962	IDE default
178	186,522	IDE default

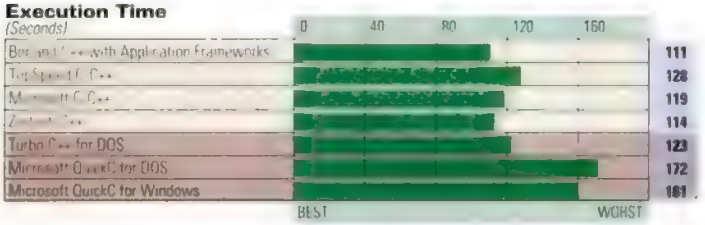
N/A—Not applicable. The product does not perform this task.

SIZE OPTIMIZATION



MAKE Time (Seconds)	Execution Time (Seconds)	Compiler Switches
101.2	117	-A- -H=xs_bc.sym -O1 -b- -v- -d
198 2	127	#pragma optimize(speed=>off)
337 6	123	/Oaes /Gs /Yu /Za /AL
127 3	113	-o+space

SPEED OPTIMIZATION



MAKE Time (Seconds)	.EXE Size (Bytes)	Compiler Switches
129 0	132,574	-A- -H=xs_bc sym -Oa2 -a -v-
199 4	123,092	None
588 9	174,023	/Oax /Ob2 /Yu /Gs /Za /AL /Gr
13 [illegible]	[illegible]	[illegible]
56 2	159 364	Optimize for speed (within IDE)
57 6	177 286	Optimize for speed (within IDE)
105 2	172,254	Optimize for speed (within IDE)

We conducted our C/C++ compiler tests on a Compaq 386/25M with a 340MB hard disk and 8MB of memory, 2MB of which was dedicated to a disk cache. Each vendor submitted the appropriate compiler settings and switches for each of the tests.

At Microsoft's request, we ran Microsoft C/C++ within a DOS box under Windows, and we also tested it under DOS; we found the differences to be negligible. The results reported for Microsoft C/C++ are the results for the Windows DOS box test. We tested all the other professional compilers directly under DOS, and we tested the entry-level compilers (highlighted with a darker tint) from within their IDEs.

C PERFORMANCE

PC Magazine Labs chose XSCHEME, a Lisp-like interpretive language authored by David Betz, to test C compiler performance for DOS applications. XSCHEME consists of 16 C source files and 5 header files—just short of 10,000 lines of code—and is in the public domain. The execution time presented for XSCHEME is the time the compiled application takes to interpret a predefined script computing the 26th number in the Fibonacci series.

On the C test, Zortech C++ and Borland C++ turned in the fastest compile times of all the professional compilers; these two compilers also generated the fastest executables. TopSpeed C/C++, with its inherently optimizing compiler, consistently produced the smallest .EXEs, but with relatively slow compile times. Microsoft C/C++ had the longest compile times of all.

C++ PERFORMANCE

PC Magazine Labs could not identify a live C++ application that did not have a bias toward one compiler or another, so we synthesized a benchmark test application based on the Rogue Wave C++ class libraries. The CPPBENCH program manipulates character strings and doubly linked list objects provided by TOOLS.H++. It consists of 11 C++ source files and 16 header files—nearly 5,500 lines of code—and is representative of real-life C++ applications in both size and complexity.

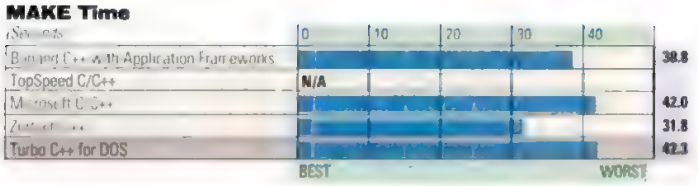
Of the professional compilers, Borland C++ produced the slowest executable version of CPPBENCH; Microsoft C/C++ was the fastest, and Zortech C++ ran a close second. Borland C++'s slowness may be due to its memory management technique. It is the only compiler that calls DOS to free memory after every deallocation, whereas other compilers do this only as needed. Borland feels that this method makes a program less likely to run out of memory when repeatedly allocating and deallocating large blocks. Borland C++ also produced the largest executables; the TopSpeed C/C++ executables were again by far the smallest.

WINDOWS PERFORMANCE

We chose The Free Software Foundation's Windows CHESS program to test compilation of programs for the Windows environment. CHESS is written in C, and it has 25 source code files and 7 header files containing over 8,500 lines of code. Because Windows programs are highly interactive, CHESS was tested only for

C++ PERFORMANCE

QUICK COMPILE



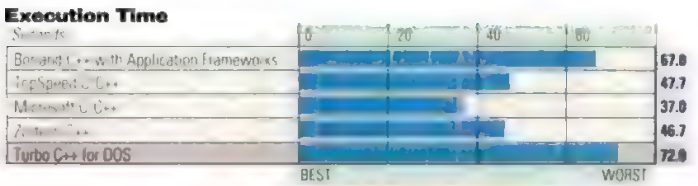
Execution Time (Seconds)	.EXE Size (Bytes)	Compiler Switches
69	99,403	-A- -H=cppbench sym -v-
N/A	N/A	N/A
50	67,808	/f /Od /Yu /Gs /Ze /AL
49	85,762	-o+none
72	108,299	IDE default

N/A—Not applicable: The product does not perform this task

SIZE OPTIMIZATION

MAKE Time (Seconds)	Execution Time (Seconds)	Compiler Switches
46.2	69	-A- -H=cppbench sym -O1 -b- -v- -d
118.8	49	#pragma optimize(speed=>off)
125.6	41	/Oaes /Gs /Yu /Ze /AL
63.5	46	-o+space

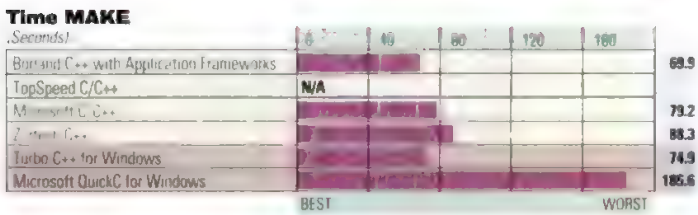
SPEED OPTIMIZATION



MAKE Time (Seconds)	.EXE Size (Bytes)	Compiler Switches
54.5	98,859	-A- -H=cppbench.sym
124.5	38,353	None
195.3	73,848	/Oax /Ob2 /Yu /Gs /Ze /AL
64.2	80,418	-o
42.5	107,713	Optimize for speed (within IDE)

WINDOWS PERFORMANCE

QUICK COMPILE



.EXE Size (Bytes)	Compiler Switches
111,104	-v -W -H=chess sym
N/A	N/A
90,320	/f /Yu /Od /Gs /Ze /GA /GEF
112,640	-o+none
121,155	IDE default
94,128	IDE default

N/A—Not applicable The product does not perform this task

SIZE OPTIMIZATION

MAKE Time (Seconds)	Compiler Switches
89.7	-H=chess sym -O1 -b- -v- -d -W
181.4	#pragma optimize(speed=>off)
91.4	/Yu /Oaes /Gs /Ze /GA /GEF
N/A*	N/A*

N/A*—Not applicable The product could not complete this test.

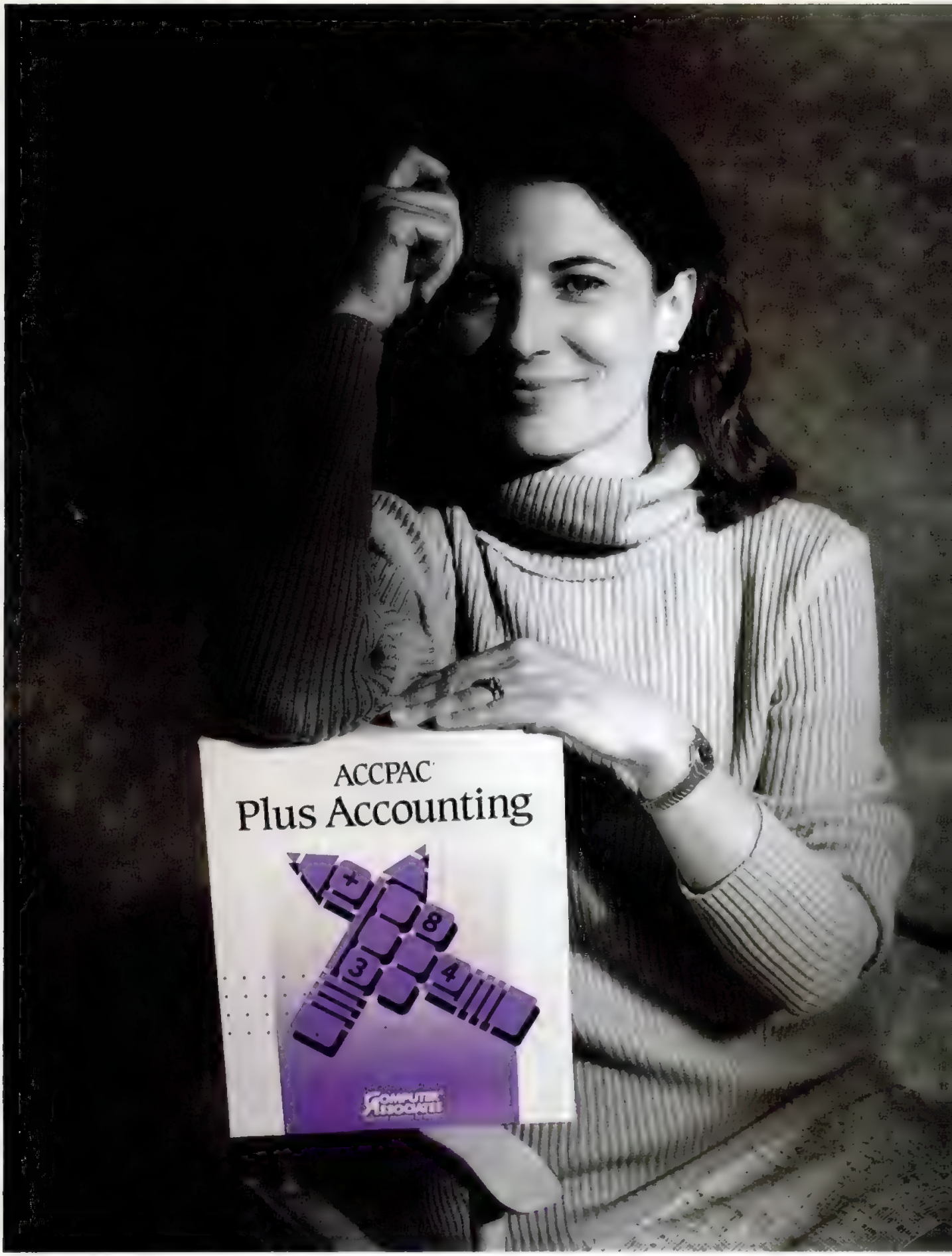
SPEED OPTIMIZATION

	MAKE Time (Seconds)	.EXE Size (Bytes)	Compiler Switches
Borland C++ 3.0 with Application Frameworks	120.7	110,080	-H=chess sym -W -Oa2 -a -v-
TopSpeed C/C++	189.3	67,568	None
Microsoft C/C++	96.7	80,784	/Yu /Ob2 /Gs /Ze /GA /GEF
Zortech C++	N/A*	N/A*	N/A*
Turbo C++ for Windows	76.1	122,179	Optimize for speed (within IDE)
Microsoft QuickC for Windows	190.9	90,528	Optimize for speed (within IDE)

N/A*—Not applicable: The product could not complete this test

compilation speed and executable size—not executable speed.

With the CHESS program, TopSpeed C/C++ once again created exceptionally small executables, but it also had the longest build time of any of the professional compilers. Borland C++ had the fastest compile time with no optimization and with size optimization. With Zortech C++, if CHESS was compiled with any optimizations enabled, the program would hang. Symantec Corp. is investigating the cause of the problem.



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ing you to write the MAKE file code yourself.

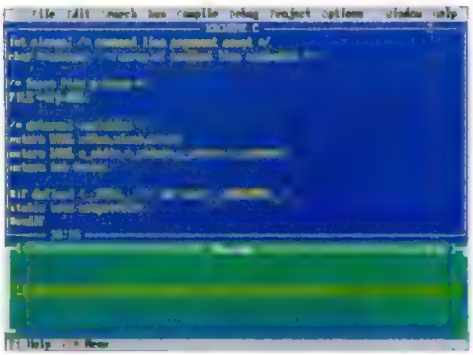
Borland C++ is the only professional C/C++ compiler we looked at that provides a Windows-hosted IDE, but the compiler in the Windows-hosted IDE is the Turbo C++ entry-level compiler, not the fully optimizing compiler provided in the DOS version of the IDE. Borland C++ 3.1 will contain a fully optimizing Windows-hosted compiler.

TOOLS, TOOLS, AND MORE TOOLS

Borland's development tools have always been its greatest strength, and a significant number of new development tools have been added to Version 3.0. In fact, a full installation can take upwards of 50MB on your hard disk. Best of all, Borland's plentiful compiler tools now utilize protected mode.

For Windows software development, the Resource Workshop adds the most powerful resource development tool sold with any compiler on the market. The integrated resource editor lets you work with all of your resources at once, without leaving the environment. You can edit menus and decompile existing resources from .EXEs, and all of the editing tools remain available when you zoom in.

The Application Frameworks libraries, which can be purchased along with the compiler, aid programmers in building the user interface. There are two components to the Applications Frameworks libraries: Turbo Vision and Object Windows Library (OWL). Turbo Vision (which was used to develop the DOS version of the IDE) lets you build user interfaces with text-based windowing under DOS. OWL makes building a Windows interface easier. Unfortunately, there is no compatibility between the two tools; you cannot use one set of statements to generate an interface under either DOS or Windows—a feature available with certain BASIC compilers.



Borland C++ with Application Frameworks writes error and warning messages to the window at the bottom of the screen; clicking on an error message highlights the relevant line in the source-code window.

Unlike some other C compilers, Borland C++ does not include a DOS extender, although third-party DOS extenders can be used. Since Borland C++ is a protected-mode compiler, it seems odd that DOS-extender technology is not included.

Borland C++ 3.0 contains some significant improvements over Version 2.0, including global optimization, DPMI support, a class browser, and enhancements to the profiler and the C++ language implementation. Version 3.0's global optimization provides optimization across source files, yet still does not noticeably slow compile time. In our testing, even when optimizations were enabled, Borland's compile times remained in the top range.

MEETING THE SPECIFICATIONS

Borland C++ now adheres to the DPMI specification, as opposed to VCPI, which was used in Version 2.0. This is necessary for running in extended mode under Windows. The profiler can now do coverage analysis (profile the efficiency of flagged lines or procedures) and Windows profiling. The new class browser, available only in Windows mode, helps C++ programmers manage their class structure. Source code for the C and C++ runtime libraries is now included at no extra charge.

Of all the products we reviewed, Borland has best kept up with the evolving C++ specification. With Borland C++ 3.0, the C++ implementation has evolved from AT&T draft 2.0 to 2.1, and there are extensions to accommodate certain AT&T 3.0 features—most notably, templates. Templates provide C++ programmers with an alternative to overloaded functions by encapsulating generic methods such as linked lists, sans data types, into a class-based template. This reduces source-code size and makes debugging easier, although it won't decrease the size of the executables. Because of the enhancements to the C++ compiler, libraries generated under Borland C++ 2.0 are not compatible with Version 3.0. If you are using third-party libraries that are not yet 3.0-compatible, you can use the backward-compatibility switch to circumvent the problem.

Unfortunately, Borland has removed its excellent C++ tutorial from the 3.0 package. Instead they are marketing two video courses, *The World of C++* and *The World of Object Windows for C++*, which are priced at $99 each.

On our benchmark tests, Borland C++ had the fastest, or close to the fastest, compile times. Its C code executes quickly, but C++ execution speed was the slowest of the bunch. In terms of size, C executables were average, but its C++ and Windows executables were among the largest.

FUTURE TRENDS

Borland's commitment to Windows is evident by both the quantity and the quality of the tools it provides for Windows programmers: the class browser, Windows profiler, OWL, and the exceptional resource editor. An unfortunate side effect of the emphasis on Windows is that Borland's attention to the DOS side seems less committed. There is no DOS extender, and the class browser is only available under Windows.

Borland C++ 3.1, which will be released around the time this review is pub-

EDITORS' CHOICE

FACT FILE

Borland C++ with Application Frameworks

Borland International Inc., 1800 Green Hills Rd., P.O. Box 660001, Scotts Valley, CA 95067; 800-331-0877, 408-438-5300; fax 408-439-9100

List Price: $749; without Application Frameworks, $495.
Requires: 640K RAM, 1MB extended memory, 15MB to 60MB hard disk space, DOS 3.31 or later
In Short: Borland C++ with Application Frameworks has it all: protected-mode implementations of C and C++, quick compilation, an intuitive IDE, painless project management, well-designed libraries, plenty of sample code, and numerous useful tools for Microsoft Windows development. The next version, 3.1, which will be released by the time you read this, will provide support for Windows 3.1

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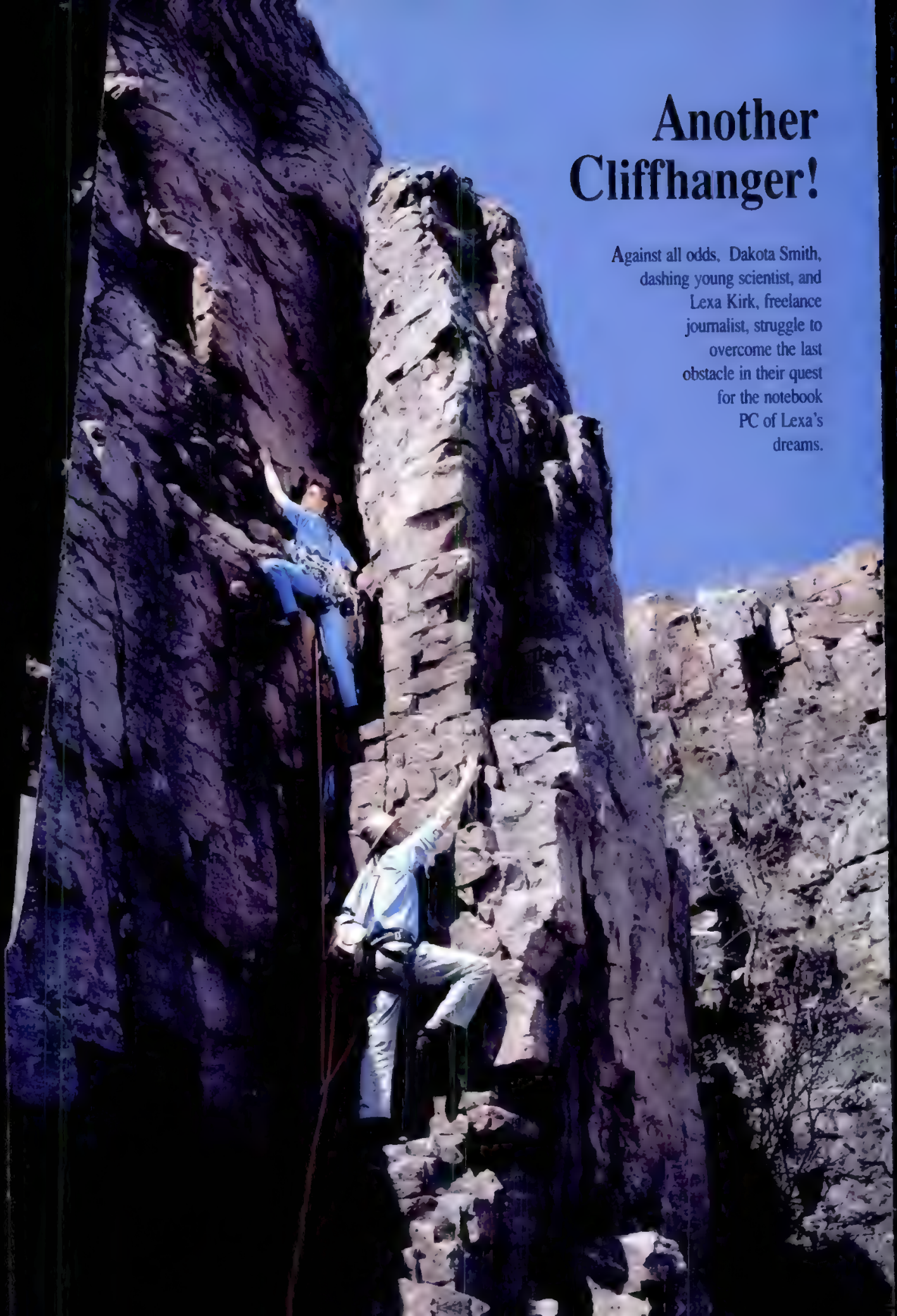


Another Cliffhanger!

Against all odds, Dakota Smith, dashing young scientist, and Lexa Kirk, freelance journalist, struggle to overcome the last obstacle in their quest for the notebook PC of Lexa's dreams.

alf!

k Treasure From Gateway 2000!

Dakota and Lexa - Gateway 2000 employees Phil and Mary -- were photographed in Palisades State Park near Sioux Falls, South Dakota.

of most notebook computers!

"The Gateway 2000 Handbook!" she sighs reverently. "What a discovery! This could be the first product in a new category of portable PCs!" Although it weighs only 2.75 pounds, the HandBook has 286-class performance, a bright, backlit screen, a real hard drive and a great keyboard.

And so, Dakota and Lexa set forth on a new mission to tell the world about their discoveries.

TO BE CONTINUED...

GATEWAY2000

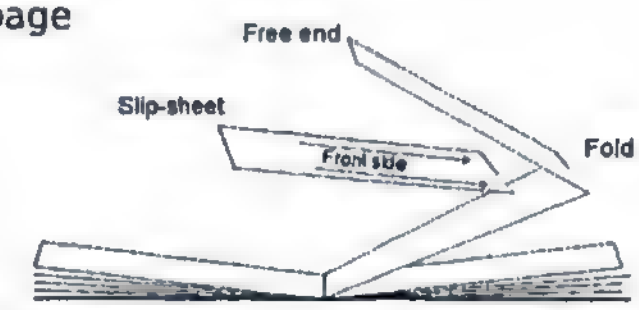
"You've got a friend in the business."

8 0 0 - 5 2 3 - 2 0 0 0

Folded edge of the page

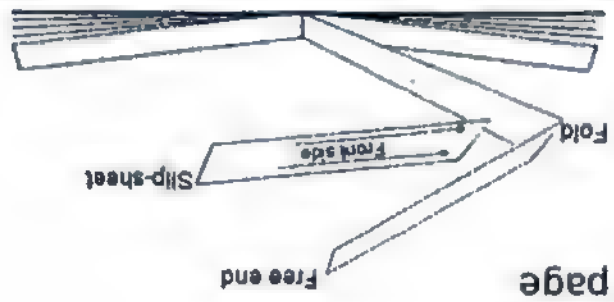
Foldout slip-sheet

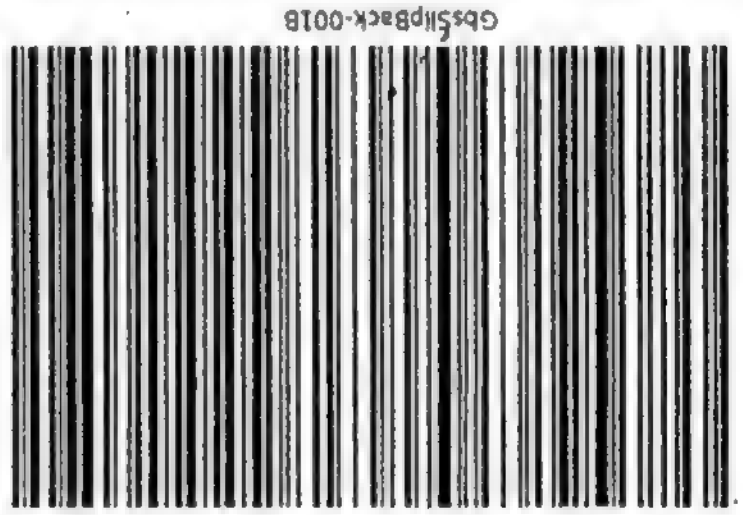
1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet





Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

Holy C

They've Discovered Another Notebo

HANDBOOK

Following the map they discovered deep inside a mysterious cave, Dakota Smith and Lexa Kirk continue on their journey. While Dakota found his notebook treasure in the form of the Gateway 2000 Nomad series, Lexa is still searching for her dream: a cross between a notebook and a palmtop. Drawn as if by mystical forces, Dakota and Lexa travel into craggy terrain. The pull grows stronger, till they are confronted by a sheer cliff. She looks at him and proclaims, "I can feel in my heart that my quest is nearly fulfilled; surmounting this one last obstacle will surely be rewarded!"

The two scale the cliff and find a most astonishing little machine — about half the size

The Explorers' Notes

The HandBook we discovered is a totally new notebook product — a real PC in miniature form!

HANDBOOK

- Weight 2.75 Lbs. (HandBook & Battery)
- Dimensions 5.9" x 9" x 1.4"
- 4-Hr.* NiMH Battery, 14-Oz. Charger, 6.5" x 2.5" x 1.5"
- Traveling Weight 3.5 Lbs. (HandBook, Battery & Charger)
- C & T® Processor, 286 Class Performance
- 1MB RAM
- 40MB Hard Drive
- Backlit 7.6" Double-Scan CGA Screen, 640 x 400 Resolution
- 1 Parallel/1 Serial Port
- 78-Key Keyboard, 101-Key Emulation, Inverted T Cursor Pad
- DOS, File Transfer Software & Serial Download Cable
- Introductory Bonus Pack
- Carrying Case

$1295

Options: FieldMouse pointing device, 2,400 bps modem, alkaline battery pack, portable printer, combo unit (3.5" drive with extra serial port and parallel port), extra batteries

In discovering the HandBook, we found what could be the first product in a new category of portable PCs. It's smaller and lighter than a notebook, but it's bigger and much more functional than a palmtop.

The HandBook's performance is comparable to a 286 system. Real PC features include a bright, backlit screen, a bonafide hard drive and a comfortable keyboard (no chiclet keys). Yet it weighs only 2.75 pounds. You can travel with the HandBook and not even know you're carrying it. When you get home, downloading information from your HandBook to your office computer is easy with the serial cable and file transfer software provided.

PC Magazine says, "Desktop PCs are faster (than notebooks)..." That was before we found the Nomads!

The Nomad notebooks we discovered are highly unusual. Our theory is they were designed to let you take desktop computer performance anywhere you go in a small, lightweight notebook. And using the patented power management system, we got over six hours of operation from a single battery on the 425DXL. Power management includes a 5.7 amp/hour battery and patented power-saving BIOS and software features.

The Nomad screens are bright and crisp. Resolution is 640 x 480, 64 gray scale, on the LCD. With 1MB video RAM, you can also display on an external monitor simultaneously. There's another Nomad characteristic that sets these notebooks apart from most others. They're made in the U.S.A.!

NOMAD Options: 2,400/9,600 bps modems, portable printer, numeric keypad, Token Ring or Ethernet interfaces, SCSI interface, memory upgrades, executive carrying case, extra batteries

**Battery life was measured with power management enabled.*

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- Dimensions 8.5" x 11" x 1.8"
- 6-Hr.* NiCad 5.7Ah Battery
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- Traveling Weight 6.7 Lbs. (Nomad, Battery & Charger)
- Backlit 10" VGA Screen, 640 x 480 Resolution, 64 Gray Scale
- Simultaneous Video with 1MB
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- External Video & Expansion Bus Ports (Ports are Full Size)
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- FieldMouse™ Pointing Device
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lished, will provide support for Windows 3.1. Borland C++ 3.1 will also provide a Windows-hosted, globally optimizing compiler, color syntax highlighting for both the DOS and Windows IDEs, and 386 code optimization. Users of Version 3.0 can upgrade to Version 3.1 for a mere $39.95.

Borland C++ is a powerful, well-designed system. Its IDE is a joy to use, letting programmers concentrate on programming rather than on the mundane mechanics of the compile/link/debug cycle. Compile times are excellent, which is important during program development. Finally, its top-notch C++ implementation and powerful Windows development tools make Borland C++ 3.0 the obvious compiler of choice if you are working in either of these areas.

Microsoft C/C++

BY BEN MYERS

After a long wait, Microsoft Corp. has finally delivered a C++ compiler. Although Microsoft C/C++, Version 7.0, is the first compiler to support Windows 3.1 development and despite superb documentation, the product is disappointing in a number of ways. The IDE is still sluggish, and the debugger (CodeView) is still launched as a separate program that is not fully integrated with the editor. And although Microsoft C/C++ now includes precompiled headers, they are difficult to use.

Microsoft C/C++ is the only compiler we reviewed that runs only on 386-based PCs or better. The good news is that its use of extended memory allows Microsoft C/C++ 7.0 to optimize large functions that could not be optimized by Version 6.0, which used only conventional DOS memory. The bad news is that you cannot use Microsoft C/C++ with your memory of choice, which will be a disadvantage for many people. You must use 386MAX, which is included in the package, as your memory manager under DOS since it provides the necessary DPMI (DOS Protected Mode Interface) services. You can also run the compiler as a DOS application from inside Windows, which has DPMI services.

Microsoft C/C++ includes the entire Windows 3.1 SDK. The new Foundation Classes provide object-oriented tools for programming in Windows. Support for the OS/2 operating system, which was a part of Version 6.0, has become a casualty of the Microsoft-IBM divorce; the OS/2 native compiler, runtime library, and header files have also since been dropped.

The Microsoft C/C++ Programmer's Workbench provides on-line help for error messages; unfortunately, it does not tie the error message and the source code together.

Microsoft's printed and electronic reference materials and examples are major strengths of Microsoft C/C++. The documentation set wins the heavyweight C++ documentation crown, with over 35 pounds (10,000 pages) of printed documentation, all neatly organized. The manuals include references and tutorials for the C and C++ languages, the Windows SDK, and use of the compiler and supporting utilities. The printed documentation is matched by on-line access to a wide range of information via the Quick Help (QH) utility from the command line, or from the development environment help menu.

THE ENVIRONMENT

The IDE, which is DOS-based, is called the Programmer's Workbench (PWB); there is no Windows-hosted IDE. PWB launches the CodeView debugger as a separate program. The debugger is not integrated with the environment as it is with Borland C++. PWB runs a little faster than it did in Version 6.0, but it is still sluggish when loading help menus, CodeView, or the profiler.

However, PWB has some powerful editing features. It supports the editing of multiple files, provides an Undo for the most recent editing operation, and allows you to select among three modes for cutting and copying text: stream, box, and line modes. Stream mode is the usual method of delimiting the start and end of where you want to cut; line mode is for whole lines. Box mode is a useful editing variant that permits editing columns of text. Macros and keyboard remapping are also supported.

Much like the Borland IDE, PWB has a MAKE file generator that uses a pop-up menu to select the source files that make up an application. It surpasses Borland in that it generates a standard ASCII MAKE file rather than a binary file that can only be read within the development environment. Because the environment generates an ASCII file, the same MAKE file can be used by the command line MAKE utility and by the IDE's project facility; no conversion is needed.

The Microsoft debugger, CodeView, has now been enhanced to support single-monitor Windows debugging. In previous versions of CodeView, two monitors were necessary when debugging Windows programs. CodeView 4.0 also adds the capability of viewing data inside C++ objects, and full tracing and breakpoints within C++ classes.

The Microsoft profiler is not just a sampling profiler; it is designed to be able to help you determine completeness of code coverage during program testing. Unfortunately, when we tried to use the profiler on any of our benchmark programs, the result was either a hung system or a 386MAX exception that required a reboot. We were unable to identify the cause of the problem.

A unique feature of Microsoft C/C++ is its use of P-Code. P-Code originally

SUITABILITY TO TASK

Microsoft C/C++

	POOR	FAIR	GOOD	EXCELLENT
Small DOS applications	●	●	●	○
Large DOS applications	●	●	●	○
Windows applications	●	●	●	●
C++ development	●	●	●	○
Portability	●	●	○	○

32-bit C/C++ Compilers

by Richard Hale Shaw

32-bit processors for the PC have been around since the introduction of the 80386. But because DOS operates in 16-bit real mode, many programs don't take advantage of their special capabilities. To derive full benefit from the 386 (or 486), you need either a 32-bit operating system such as Unix, IBM's OS/2 2.0, Microsoft's Windows NT (expected later this year), or a 32-bit DOS extender.

DOS is fundamentally limited in two ways: It cannot access memory above 1MB without external help, and it can access only 64K of contiguous memory at one time.

Because DOS operates in 16-bit real mode, many programs can't utilize 32-bit processors.

The 1MB limit exists because DOS operates in real mode for compatibility with older processors. There is a 64K maximum because 65,535 is the greatest value that you can count to with 16 bits. 32-bit DOS extenders circumvent these limitations by switching the processor from 32-bit protected mode to 16-bit real mode and back again every time your program calls a DOS system function.

With 32-bit memory addresses, the 386 can access up to 4GB of contiguous physical memory (since the maximum value you can count to with 32 bits is approximately four billion).

You aren't limited to addressing physical memory either. The 386 can address up to 64 terabytes (2 to the 46th power) of virtual memory via the built-in paging hardware, which can map virtual addresses to real ones.

Another benefit of 32-bit operation is protected mode, which makes it virtually impossible for one application to violate another's memory space accidentally. Such violations are trapped by the hardware and result in the offending application being terminated without causing disruptions to other applications or to the operating system.

Remember how .COM files work? They are very simple to write because every address is near. You don't need to specify segments since a single segment value is used for all the segment registers. The only requirement is that everything in your program—code, data, and stack—must fit into 64K.

32-bit applications are a lot like COM files, only bigger. Their flat memory model uses straight 32-bit addresses rather than segments and offsets, so every address is near. The only limitation is that everything in your program—code, data, and stack—must fit into 4GB.

DOS EXTENDERS

Since most PCs today use DOS as their operating system, DOS extenders are an important part of the 32-bit compiler story. DOS extenders are generally bound directly into applications. With Phar Lap, you must purchase the 386|DOS-Extender Redistribution Kit to obtain the version that can be bound in, or you can run the Phar Lap extender from the DOS command prompt with the name of your application as an argument.

Exactly how much total memory is made available depends on the DOS extender; some only provide access to 32MB, while others provide a full 4GB to your DOS-extended application. Among the more popular DOS extenders are: DOS/4GW, from Rational Systems (Natick, Massachusetts); 386|DOS Extender, from Phar Lap Software; OS/386 DOS Extender, from Ergo Computing (Peabody, Massachusetts); and the DOS extender included in the Intel 386/486 Code Builder Kit, from Intel (Hillsboro, Oregon). But to write 32-bit code with a DOS extender, you need a 32-bit compiler.

WATCOM C9.0 /386

Watcom C9.0 /386 (from Watcom in Waterloo, Ontario, Canada) lets you write 32-bit applications under Windows 3.*x*, OS/2 2.*x*, and several DOS extenders, including 386|DOS Extender, OS/386, Code Builder, and DOS/4GW, which is included in the package. There are no royalties on applications that use DOS/4GW, which can access virtual memory up to 32MB, has a 25K real-mode footprint, and provides DPMI, VCPI, and XMS compatibility.

The Watcom compiler is simple to use but powerful, and is provided in both real- and protected-mode versions; if you have the hardware, you can get the benefits of 32-bit processing while running the compiler, too. The package is professional, well organized, and complete; it offers a full complement of development tools. Also, Watcom's compiler supports optimizations such as instruction reordering that packages such as Microsoft C/C++ do not.

Watcom supplies portions of the Windows SDK with the package, so you can use it to write 32-bit Windows applications and DLLs. There's a 32-bit interface to Windows' 16-bit API and a 32-bit library. And the package offers multimodel support and niceties such as defining the macro __FLAT__ when you compile for the flat memory model, the same way other compilers define __LARGE__.

Watcom's C++ was still in the wings at presstime; it will probably be a while before you can write 32-bit C++ applications with this compiler. Nevertheless, at $895, this C package is a high-quality professional's package.

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32-bit C/C++ Compilers

CONTINUED

MICROWAY NDP C|C++ 486

Microway's NDP C|C++ 486 (Plymouth, Massachusetts) has traditionally focused on numerically intensive scientific and financial applications rather than mainstream commercial applications.

The compiler supports ANSI C; AT&T C++, Version 2.1; and K&R C++. You can run NDP from the DOS command line or from a menu-driven interface. The package comes with the GREX library, a pixel- and character-based graphics library with sound generation, and port and interrupt I/O control.

NDP's greatest strength is in writing code to utilize a numeric coprocessor like the 387. It offers extensive control over code generation for the coprocessor—down to the type of coprocessor on the target machine. The compiler can also perform techniques like common subexpression elimination more than once on a piece of code. Additionally, it can perform a global data-flow analysis, as well as maximize the use of the 386 and coprocessor registers. There's even control over the data storage technique used, depending on the coprocessor on the target machine.

If you spend the $995 to obtain the NDP C/C++ 486 version (the 386 version is $695), you won't be spending it on the manuals—two loose-leaf binders with pages that look photocopied. And since you'll need to purchase the Phar Lap SDK separately to create 32-bit applications, this isn't the best buy for 32-bit programming. (The company has a version in beta that will not require the Phar Lap package.) Still, the compiler offers 32-bit C++; the only other compilers that do are Zortech C++ and, by the time you read this, MetaWare High C++.

METAWARE HIGH C

Just as we went to press, MetaWare (Santa Cruz, California) began to ship its 32-bit C++ compiler, High C/C++ 3.0. However, we evaluated High C, Version 2.4, since Version 3.0 was not yet available during testing.

You can build 32-bit applications with MetaWare High C using Phar Lap's 386|DOS. MetaWare High C also offers extensive support for building 32-bit Windows applications that run under Windows 3.*x*. There's a 32-bit Windows 3.*x* application development kit and a 32-bit source debugger is included. In addition, the compiler can perform a number of global optimizations on your programs.

For the $795 list price, MetaWare also throws in Rogue Wave's numerical tools, and for $200 more, you can pick up the Phar Lap SDK, too. This is a powerful, professional package; the addition of 32-bit C++ capabilities in the new package (also $795) will make it even more appealing.

Zortech is probably the best all-around tool for C and C++ 32-bit programming.

ZORTECH C++

The Zortech C++ compiler (see review in this issue) has an option that lets you switch between 16-bit and 32-bit application development. Zortech C++ includes a royalty-free DOS extender called DOSX, but you can use the Phar Lap DOS extender if you prefer.

We found Zortech C++ to be the easiest compliler to use when creating DOS-extended applications. DOSX is bound directly into the .EXE. It only adds about 10K to the application, and is both VCPI and DPMI compatible. However, DOSX doesn't provide support for programs that run half in real mode and half in protected mode, and it doesn't check for older 386 chips, which sometimes have incompatibilities with DOS extenders.

As with Watcom, a 32-bit extended version of the compiler lets you obtain the benefits of 32-bit processing during development. Zortech's graphics library and mouse interface all work with 32-bit applications, and as an added bonus, its floating-point implementation is completely IEEE-compliant. For $699, Zortech is probably the best all-around tool for C and C++ 32-bit programming.

INTEL 386/486 C CODE BUILDER KIT

The Code Builder package is based on Microsoft C; the compiler and libraries claim to be strictly Microsoft C–compatible. The package includes a source-level debugger that resembles older versions of CodeView, a librarian, MAKE capability, and a 387 coprocessor emulator package. However, runtime library documentation is not included with the package: you'll have to purchase the Microsoft C Runtime Library documentation that is supplied by Microsoft Press. (This obstacle is remedied in Version 1.1, which began shipping just after our press deadline.) There are other quirks with the package as well. The compiler couldn't handle // comments in our source programs unless the */znoansi* switch was used.

The DOS extender and virtual memory manager are DPMI-compliant, and there are no royalties on applications built with them. The extender code is built into each application. It can easily add 300K to the .EXE, compared with a mere 10K for Zortech. Each DOS-extended application has access to 32MB of memory.

As we went to press, Code Builder, Version 1.1, was being prepared for release. It includes support for memory managers such as 386MAX, QEMM-386, and NetRoom. The new version will also offer debugging and floating-point emulation under Windows 3.*x* along with the sorely missed runtime library documentation. Also with Version 1.1, larger applications will have a virtual address space of up to 3.74GB and a physical address space of up to 64MB. This new and improved version is not a bad buy at $695. □

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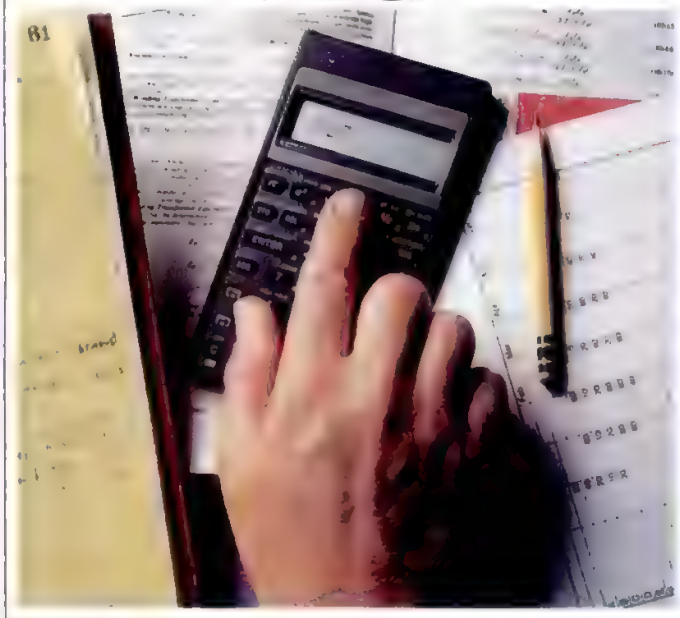

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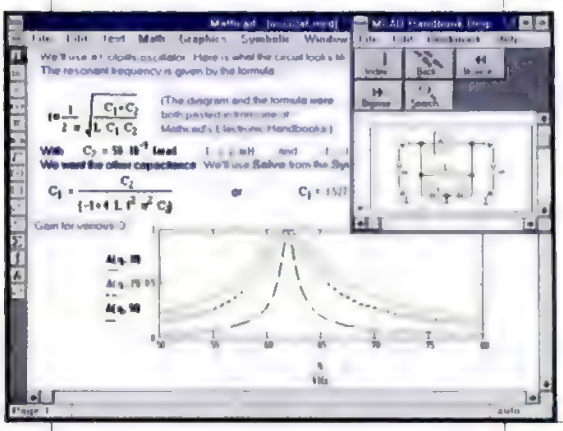

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FACT FILE

Microsoft C/C++, Version 7.0

Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080, fax 206-936-7329

List Price: $499
Requires: 386-based PC or better, 4MB RAM, 15MB to 60MB hard disk space, DOS 3.3 or later
In Short: A comprehensive, superbly documented system for DOS 3.0 or Microsoft Windows 3.1 applications development. Though all of the pieces are there, the implementation is often less than top notch. The precompiled header facility is awkward, the debugger isn't well integrated with the editor, C++ templates are not supported, and its manner of accessing extended memory precludes the use of QEMM and other popular products. Compile times are slow, and the development environment is sluggish.

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stood for "pseudo-code," but Microsoft has resurrected it as "packed code." P-Code is semi-compiled source code that is executed with an interpreter, which reduces executable size at the expense of executable speed. After profiling your application and analyzing the results, you can choose to compile little-used modules or functions with P-code. The MPC (MAKE P-Code) utility binds a P-code interpreter to the compiled application.

Microsoft C/C++ also features precompiled headers, a time-saver that keeps you from having to recompile large header files such as the Windows header file each time you build your program. However, the package's precompiled headers are so difficult to use that you may not want to bother. You either have to insert the HDRSTOP PRAGMA into each source code module to tell it where the precompiled headers stop, or you must put all your precompiled headers in the same order and then use a compiler option to let it know which is the last precompiled header.

Precompiling headers is a separate compilation step, and if you change something in your header file, it's up to you to remember to recompile the headers. With Borland C++, where precompiled headers originated, this is automatically done for you. Microsoft stresses that with Microsoft C/C++ you are able to precompile executable code in addition to declarations.

HOW FAST IS IT?

Microsoft Corp.'s C compilers have a reputation for producing high-quality code, but on PC Magazine Labs' benchmark tests, Microsoft C/C++ delivered mixed results. In compilation time, Microsoft C/C++ was generally the slowest—often by a large margin. But in execution speed, it performed respectably on the C tests, and was the fastest of all for most of the C++ and Windows tests. The sizes of the compiled programs were among the largest for the C tests, but among the smallest for the C++ and Windows tests.

Microsoft C/C++ is a comprehensive and powerful development system, but it never quite shines. Its development environment, C++ implementation (templates are not supported), and precompiled header implementation all lag behind Borland's. And though its C++ executable times are among the fastest, its C times drag. Provided they have no interest in developing OS/2 applications and they're willing to use 386MAX for memory management, many programmers—especially dedicated users of Microsoft C, Version 6.0—will welcome this product.

TopSpeed C/C++

BY THOMAS SIERING

Clarion Software's TopSpeed C/C++ takes an original approach. Rather than a dedicated one-language development system, Clarion Software (which recently purchased JPI, the original marketer of TopSpeed) offers a mix-and-match approach. The open-architecture TopSpeed development environment does not include a compiler, but instead contains hooks for plugging in the compiler of your choice. Even third-party compilers can be used within the environment, but if you buy one of the TopSpeed compilers (C, C++, Pascal, Modula-2, or the soon-to-be-released Clarion Compiler, Version 3.0, for database programming), you can take advantage of the highly efficient TopSpeed linker. Up to four compilers can be plugged into the development environment simultaneously. An Intermediate Sequential Language (ISL) generator within the environment makes all TopSpeed tools and libraries available from any language.

SUITABILITY TO TASK
TopSpeed C/C++

	POOR	FAIR	GOOD	EXCELLENT
Small DOS applications	●	●	○	○
Large DOS applications	●	●	●	●
Windows applications	●	●	○	○
C++ development	●	●	○	○
Portability	●	●	●	○

The TopSpeed pricing scheme is flexible. You can purchase the Standard Edition, consisting of the environment and one compiler for just $198. Each TopSpeed component costs $99. The C++ Master Edition has six components: the environment, the C++ compiler, the C++ runtime library source code, the C runtime library source code, the TechKit (which contains support for Windows, DOS DLLs, and other tools), and an OEM version of the Rogue Wave class library of mathematical and scientific functions.

We reviewed the Master Edition with three optional components: the C compiler, the no-royalty 16-bit DOS extender (32-bit versions of the TopSpeed compilers are planned for the end of this year) and the extended-memory version of the environment. (The DOS extender and the extended environment cannot be purchased separately.) The total cost for these nine modules is $891.

First impressions of TopSpeed may sell it short. While the product, despite its discrete components, is nicely integrated, the manuals are disjointed, incomplete, and poorly indexed. Once information on a topic of interest has been located, the explanation given is frequently too brief and superficial. Useful and powerful features are easily overlooked since they are not clearly identified. Technical support, product upgrades, and tutorial code samples can all be obtained through the company's bulletin board system.

TopSpeed brings several significant extensions to DOS programming, including functions for real-mode multitasking and DLLs (dynamic link libraries).

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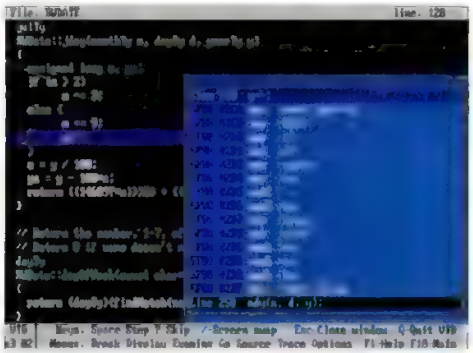
TopSpeed has provided the facility for writing concurrent procedures under DOS since 1986. DLLs, which are typically found only in Windows and OS/2 applications, give TopSpeed developers the ability to upgrade their programs by simply shipping out a new DLL, without having to rebuild the .EXE. In fact, this technology is used to incorporate the TopSpeed compilers into the development environment. The multitasking functions and DLLs are a direct port from OS/2, the environment under which TopSpeed was developed, and so multitasking DOS programs can be recompiled under OS/2 1.*x* without modification.

TopSpeed's C compiler is fully ANSI-compliant, and its C++ compiler implements the AT&T Version 2.1, specification. Code optimization is inherent and cannot be turned off. This prevents truly fast compiles and also may make some developers nervous. Execution times are respectable but not exceptional; the real strength lies in the compactness of the executables, where TopSpeed consistently outperforms the competition. Code optimization plays a role in this since optimization removes unneeded code, but this benefit is only partly due to code optimization; TopSpeed's linker deserves most of the credit.

TopSpeed's linker is possibly the most remarkable tool in this package. Linking is type-safe; data types are checked across source files. This is an especially useful feature when programming in C, which doesn't have the strong type-checking found in C++. With TopSpeed's proprietary Smart Linking, unused static methods, code, and data are excluded from the .EXE; when an object module is included in a link, only its pertinent parts will be included in the executable. SmartMethod Linking goes further to exclude unused virtual methods as well. Together, Smart Linking and SmartMethod Linking result in impressively small executables. These advanced features, along with type-safe linking, can only be used in conjunction with TopSpeed's own compilers.

TopSpeed includes a number of lint-like features that anyone who has ever endured the pains of debugging C or C++ code will appreciate. Runtime checking can be enabled for many more conditions than most compilers support. These include stack overflow, null pointer dereferencing, array boundary integrity, and numerical range overflow. Null pointer trapping goes beyond the typical one-line alert that a null pointer is lurking somewhere within your program code. TopSpeed's clever null pointer dereferencing lets you pinpoint exactly where the null pointer is located by initializing dynamic memory to zero.



TopSpeed includes a disassembler among its many utilities. This TopSpeed screen shows the assembly code version of line 128, which is highlighted for easy reference and debugging.

Several handy utilities are also included. A watch utility lets you track a program's use of DOS services by monitoring interrupts and writing the activity to a log. Postmortem debugging lets you take a snapshot of memory and registers after a program's demise. A calculator, a disassembler, and tables for ASCII and keyboard scan codes are also provided.

TopSpeed's project management facility is also unusual. It uses a streamlined syntax all its own, and unless you are running from the command line, you don't need to write anything—not even a list of source modules—for TopSpeed to know about the dependencies in the various components of your application.

The catch is that you must create separate header files for each source module. This allows TopSpeed to divine the dependencies based on what's included where. The dependencies are determined on the fly and they are not written to a file for later use.

The TopSpeed IDE makes all of the product's functionality accessible through one central menu bar. The manual encourages use of the keyboard over the mouse to navigate the menus, and mouse support is disabled by default. Users who enable the mouse will soon discover that the mouse interface is very poorly implemented. Menu selections require a double-click, which flies in the face of any established standard. When using the extended environment, mouse usage can crash the environment altogether.

TopSpeed's Windows support is minimal. There is only the required Windows libraries, a resource compiler, and a meager 20 pages of documentation that is interspersed amid numerous unrelated utilities as part of the TechKit.

To do Windows programming with TopSpeed, you will need to purchase the Windows SDK. Although no productivity aids such as class libraries are provided, the open-architecture environment lets you easily plug in third-party development tools.

Despite its drawbacks, TopSpeed has a lot to offer. It's an excellent choice if you need multilanguage integration or if you're writing large programs under DOS. DOS receives a significant functional boost in areas such as DLLs and multithreading. Memory constraints are fought both by consistently small .EXE sizes and the DOS extender option. On the downside, the user interface desperately needs a make-over in the area of mouse support, the manuals are woefully inadequate, and Windows support is skeletal. TopSpeed's strong points, however, make it definitely worth considering for your development system.

FACT FILE

TopSpeed C/C++, Version 3.02

Clarion Software Inc., 150 E. Sample Rd., Pompano Beach, FL 33064; 305-785-4555; fax 305-946-1650

List Price: Standard Edition, $198; Master Edition, $594; additional language modules, $99 each, DOS extender with extended environment, $198
Requires: 640K RAM, 5.5MB hard disk space, DOS 3.0 or later, or OS/2 1.3 or later
In Short: TopSpeed C/C++ offers multilanguage programming support, multitasking and DLLs under DOS, and tiny executables due to its advanced Smart Link technology. Windows development tools must be purchased through third parties and you'll need to purchase the Windows SDK. Product components are sold separately for maximum customizability

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▶ SUMMARY OF FEATURES

C/C++ Compilers

Products listed in alphabetical order ■ = YES □ = NO	PC EDITOR'S CHOICE Borland C++ with Application Frameworks	C/C++ Compilers Microsoft C/C++	TopSpeed C/C++	Zortech C++	Microsoft QuickC for DOS
List price	$749.00	$499.00	$891.00	$699.00	$99.00
Compiler Features					
AT&T C++ version adherence	2.1*	2.1	2.1	2.0	N/A
Size and speed optimization	■	■	■	■	■
Global	■	■	■	■	□
Optional	■	■	□	■	■
Precompiled headers	■	■	□	□	□
32-bit code generation	□	□	□	■	□
Assembler included	■	□	■	□	□
Programing Tools					
Class browser (C++ only)	■	■	□	□	N/A
Profiler	■	■	■	■ (sampling only)	□
User-interface libraries	■	■	□	■	□
DOS	■	□	N/A	■	N/A
Windows	■	■	N/A	□	N/A
Windows programming	■	■	■	■	□
Resource compiler	■	■	■	■	N/A
Resource editor	■	■	□	□	N/A
SDK or equivalent	■	■	□	■	N/A
Debugging Features					
Windows–hosted debugger	□	■	□	□	□
C++ debugging	■	■	□	■	□
Hardware debugging	■	□	□	□	□
Interrupt debugging	■	□	■	□	□
386 high-memory debugging	□	□	□	■	□
Development Environment					
Integrated debugger	■	□	■	□	■
Windows-hosted	■	□	□	□	□
DOS-hosted	■	■	■	■	■
Extended-memory support (VCPI, DPMI)	■	■	■	■ (compiler only)	□
OS/2-hosted	□	□	■	■	□
Third-party program launch	■	■	■	■	■
Memory Management					
DOS extender	□	□	■	■	□
Overlays	■	■	■	■	□
Runtime Checks					
Array boundary checking	□	□	■	□	■
Numerical range overflow	□	■	□	■	■
Null pointers	■	■	■	■	■
Stack overflow	■	■	■	■	■

* Templates, a Version 3.0 feature, is also implemented

N/A—Not applicable. The product does not have this feature

Entry-level Compilers		
Microsoft QuickC for Windows	Turbo C++ for DOS	Turbo C++ for Windows
$199.00	$99.00	$149.95
N/A	2.1*	2.1*
■	■	■
□	■	□
■	■	■
□	■	■
□	□	□
□	□	■
N/A	□	■
□	□	□
■	□	■
□	N/A	□
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Zortech C++

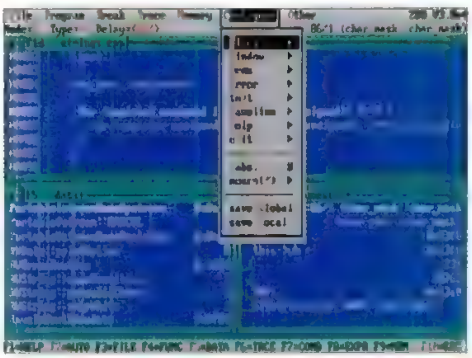
BY BEN MYERS

There are several things that make Zortech C++ unique. It has the ability to generate either 16-bit or 32-bit code, and it can produce applications for any of four platforms: DOS, Windows, OS/2 1.x, and Xenix. Code compilation is quick, and the resulting executables are generally the fastest of all the compilers we tested. In addition, Zortech C++ is the only C/C++ compiler to implement the IEEE floating-point standard and extensions.

Despite its strengths, Zortech C++ has some significant drawbacks. The development environment lacks an automatic project MAKE facility, the documentation is poorly organized and incomplete, and a compiler bug prevents compiling Windows programs with optimization.

THE ZORTECH WORKBENCH

Zortech's integrated development environment, the Zortech Workbench (ZWB), is easy to use, with close integration between the editor and the compiler. When you click on compiler errors, the cursor in the source code window jumps to the statement that generated the error. There are separate debuggers for DOS, Windows, OS/2 and remote debugging. The Windows debugger permits single-monitor debugging of Windows applications by switching back and forth between its interface and the Windows screen.



Zortech C++ windows allow simultaneous viewing of source code, global variables, and automatic variables.

Zortech C++ has more compilation options than any other compiler we looked at. The Zortech control program (ZTC) will load the various compiler and linker modules available, depending on the options you've chosen. Options include conventional memory, 286 extended memory, or 386 extended memory. Zortech C++ includes its own royalty-free DOS extender and is compatible with DOS extenders from Phar Lap and Rational Systems. Another option lets you generate 16-bit or 32-bit code by selecting the 8086/8088, 80286, 80386, or 80486 chip sets. You can choose ANSI standard or relaxed C, but not the older Kernighan & Ritchie (K&R) C. There is an option for automatic prototyping, however, for handling K&R style code.

NOT SO EASY TO USE

Warnings from the compiler are cryptic and uninformative. You must refer to the C++ compiler guide for expanded explanations. Compiler messages are not categorized, only numbered, and you must specify warning messages by number in order to suppress them. Since they are listed alphabetically in the manual without their message numbers, this is a serious obstacle.

Although you can access most compiler and linker options through menu selections, this is of little benefit when you are building an application with more than one source module since, unlike the other compilers reviewed here, you have to write a MAKE file. This can be done using the editor within the environment, but there is no on-line help to lead you through the vagaries of MAKE file syntax, nor is there on-line help for the compiler and linker switches. There is a utility called MAKE-DEP that analyzes source modules and writes the dependencies to a file, but it's not a complete MAKE file program. You must edit one of the Zortech-supplied sample MAKE files and paste in the dependencies to get a workable MAKE file. If you want to do a full build of your program, you must leave the environment and delete the component object modules to do so.

While there are plentiful and well-documented sample programs, both the

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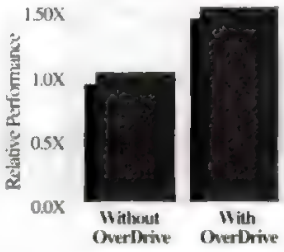

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SUITABILITY TO TASK
Zortech C++

	POOR	FAIR	GOOD	EXCELLENT
Small DOS applications	●	●	○	○
Large DOS applications	●	●	●	○
Windows applications	●	○	○	○
C++ development	●	○	○	○
Portability	●	●	●	●

on-line help and printed documentation are weak. The on-line help is restricted to explanations of how to navigate within the environment; you must rely on the manual for information on the compiler and linker switches. It is difficult to find things in the manual, even with the index, and the explanations, once found, are often unclear. The manuals are also somewhat out of date. Symantec released Version 3.04.r4 of Zortech C++ last November, shortly after acquiring Zortech. README files explain the many corrections and enhancements incorporated into Zortech C++ after the manuals were printed.

PROBLEMS WITH WINDOWS PROGRAMMING

When PC Magazine Labs tried to run the Windows benchmark test program (CHESS) compiled with either size optimization or speed optimization, it caused a system hang. The program could only be run successfully when optimization was

FACT FILE

Zortech C++, Version 3.0.r4

Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014-2132; 800-222-2616, 408-253-9600

List Price: $699.
Requires: 386-based PC or better, 640K RAM, 35MB hard disk space, DOS 2.0 or later, OS/2 1.x.
In Short: Zortech C++ supports development on any of four platforms: DOS, Windows, OS/2 1.x, or Xenix. A DOS extender is provided in addition to support for third-party DOS extenders, and either 16- or 32-bit code can be generated. Zortech C++ is the only C/C++ compiler that complies with the IEEE floating-point standard and extensions. The development environment suffers from the lack of project MAKE facilities, and the documentation is poor.

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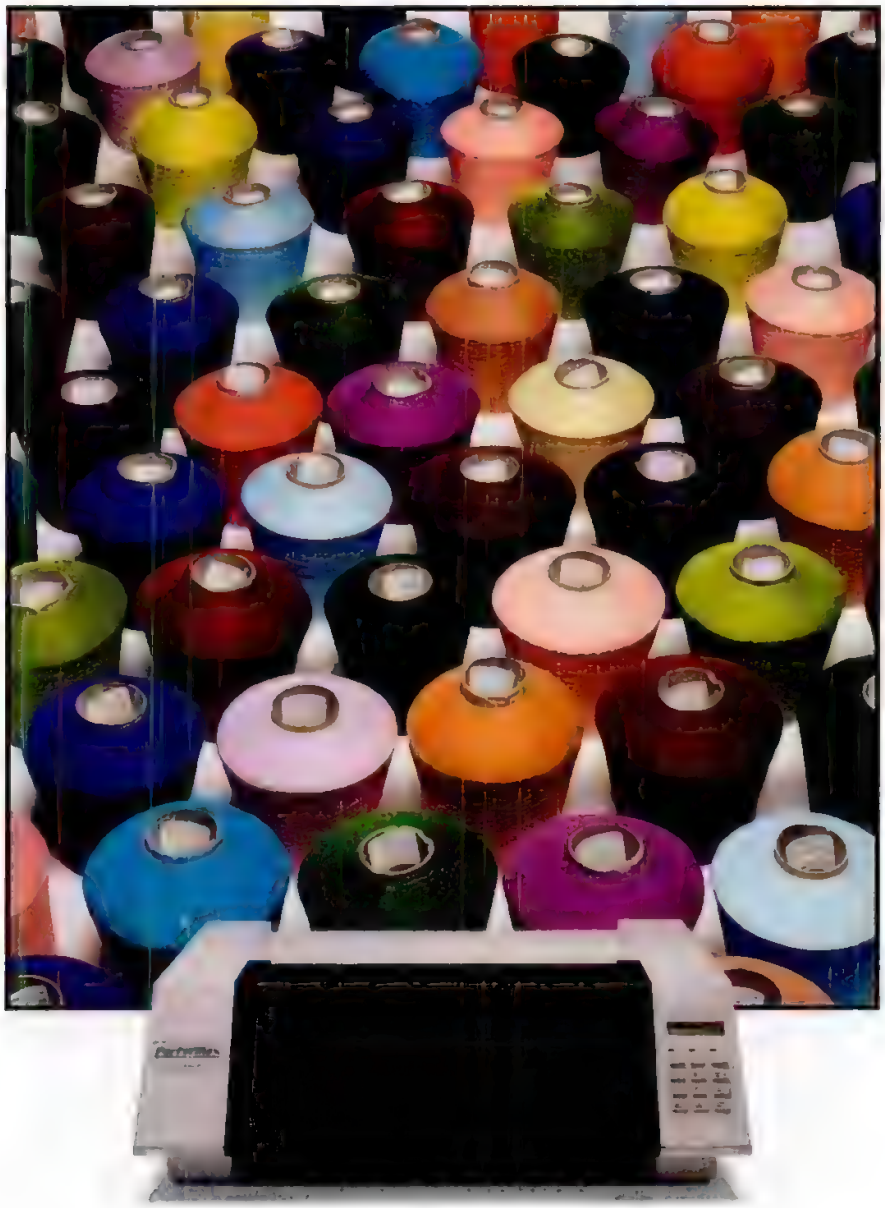

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turned off. This appears to be due to a bug in the compiler.

Linking the CHESS program required a special switch instructing the linker not to pack code segments. Without it, the code segment grew to more than 64K. A switch of this type is not necessary with any of the other compilers and linkers we reviewed.

There is a useful help compiler that transforms Rich Text Format (RTF) files into Windows help files viewable with the standard Windows help system. A resource compiler is included, but no resource editor. The Windows 3.0 SDK is included with the product.

An OEM version of WindowsMaker, from Blue Sky Software, is bundled to help you design Windows menus and dialog boxes. WindowsMaker's simulation mode lets you try out an interface without programming it first. There are no class libraries for developing Windows programs.

A SOLID SET OF PROGRAMMING TOOLS

Zortech does include a variety of non-Windows class libraries. There are classes for data handling, mathematics, text-based windows, and more. The classes are largely independent of one another rather than being derived from a small set of abstract classes, so using them won't burden your program with high overhead. The C++ Tools manual explains all of the class libraries thoroughly and walks you through sample programs that exercise the various objects. It is the best of the Zortech documentation.

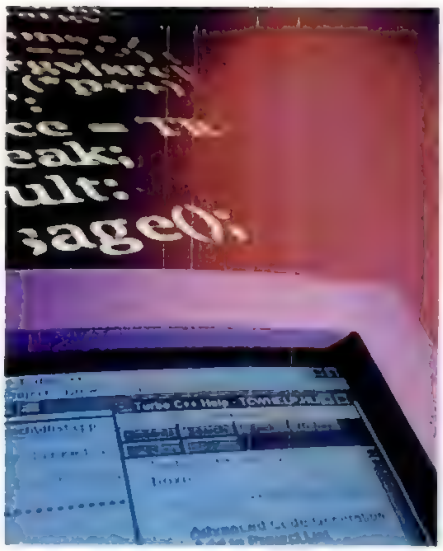
Zortech is not easy to use. The poorly organized documentation makes even the most basic tasks arduous. The lack of an automatic project MAKE file facility is a serious drawback. We can hope that Symantec will take the excellent technology built into Zortech C++ and smooth out the rough edges, even though the company has not yet done so in the year it has owned it.

For now, if you want to do Windows programming, you should look elsewhere for a compiler since you cannot produce optimized Windows programs that run reliably. But if you want the flexibility of C with the kind of IEEE floating-point implementation usually found only in FORTRAN compilers, then this is the compiler for you.

THE LOW-COST ALTERNATIVE

Entry-Level C/C++ Compilers

Not everyone needs a full complement of professional development tools. Streamlined but capable, here are four low-cost alternatives for C/C++ programming under DOS and Windows.



PHOTOGRAPH BY JOHN WILKES

by Rudyard Merriam

While Borland and Microsoft's professional-level compilers provide both DOS and Windows programming capabilities in a single box, with entry-level C/C++ compilers you must make a choice between DOS and Windows. Borland's Turbo C++ and Microsoft's QuickC come in two different versions: one for DOS and one for Windows. The only crossover in functionality is in QuickC for Windows, which provides the capability of compiling DOS programs, although there's no DOS debugger.

All four entry-level compilers list for under $200, compared with professional-level C/C++ compilers that are priced in the $500 to $800 range. While they lack some of the features of their professional counterparts, such as optimizers and profilers, they provide access to ANSI-compliant C (and, for the Borland products, C++) via an integrated development environment (IDE), which gives you menu-based access to the editor, debugger, linker, and other compiler tools.

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There are some important differences between the two DOS compilers. QuickC for DOS, unlike Turbo C++ for DOS, can edit only one file at a time—a significant disadvantage. QuickC for DOS operates only in real mode—there is no access to extended memory. Turbo C++ for DOS runs only in extended memory, and a 286-based PC or better is required. The use of extended memory allows the Turbo C++ IDE to load much larger programs than QuickC, but if you want to program for DOS on an XT-class computer, QuickC is your only option.

Development tools are crucial if you're interested in Windows programming. Borland provides user interface libraries for both the DOS and Windows versions of Turbo C++, and a top-notch resource editor—the same resource editor found in the professional version of the product. QuickC's tools pale by comparison. For example, the resource editor

in QuickC for Windows has only a fraction of the functionality of the Borland version.

While the IDE and development tools are important, the quality of the compiler itself is central. Both Turbo C++ and QuickC fully implement the ANSI C standard, but only Turbo C++ provides support for the C++ language extensions. That alone gives the Borland products an undeniable edge.

Before you make a final choice, take a look at the TopSpeed development system reviewed earlier in this issue. It's sold in modules that can be purchased separately for $99 each; for $198, you can buy just the IDE and a C compiler now, and then add a C++ compiler or development tools later, as needed. TopSpeed provides a clear growth path, but its cryptic documentation may be too great a burden for the novice.

Turbo C++ for DOS
Microsoft QuickC for DOS

BY RUDYARD MERRIAM

At first glance, Turbo C++ for DOS and QuickC for DOS look remarkably similar since both use the Common User Access (CUA) interface standard in their IDEs.

In addition, both Turbo C++ and QuickC provide a command line compiler, linker, librarian, graphics library, and an integrated debugger, which lets you step through your program, set break points, and monitor variables. But despite these outward similarities, the capabilities of the two packages are widely divergent.

TURBO C++ FOR DOS

The Turbo C++ IDE is both sophisticated in its capabilities and intuitive to use. Version 3.0 introduces color syntax highlighting in edit windows, which can help beginning programmers spot the elusive C pointer errors that can haunt the neophyte.

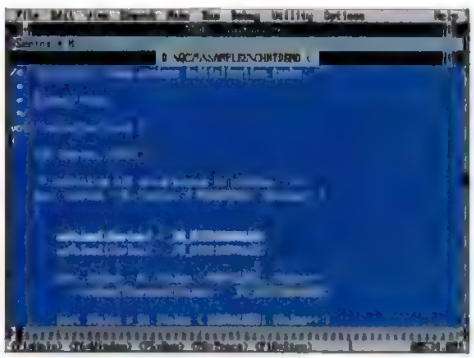
You'll need a 286-based PC or better to run Turbo C++. While this leaves out programmers who still use 8086/8088 computers, new programmers can compile and debug larger programs, so they won't outgrow the compiler so quickly.

One advantage of Turbo C++ over QuickC is its ability to edit multiple files simultaneously. If your program is even moderately large, you will want to group related functions together in separate files. This facilitates a modular design and is a hallmark of good programming. QuickC does not support multiple-file editing.

To compile and link multiple source files in Turbo C++, you need only list the files in the project window, and dependency information is generated automatically. One drawback of the IDE's project MAKE facility is that the generated project file is not in standard ASCII MAKE format, and thus can't be used from the command line. There is a conversion utility, but be warned: Due to the extensive use of macros, the file that is produced is nearly indecipherable. If there are errors in the resulting MAKE file, which sometimes occurs, you'll have a hard time locating and fixing the problem.

The Turbo C++ compiler supports ANSI C, Borland-extended C, Kernighan & Ritchie (K&R) C, Unix C, and C++. In any of these modes, the compiler generates informative error messages that explain the problem, and additional information is available from the help system. As you move through the error messages, the relevant source code lines are highlighted in the edit window.

A major advantage of Turbo C++ over QuickC is its implementation of C++. In addition to the editing, compiling, and debugging capabilities, there is a class browser that provides a visual representation of your class structure. A set of C++ class libraries aids in user interface development and also provides useful examples of C++ code.



The Microsoft and Borland entry-level DOS packages both use a CUA-compliant interface. The QuickC debugger shown here is displaying a watch on a variable in the small upper window.

QUICKC FOR DOS

QuickC for DOS is an adequate effort but has many limitations. The IDE does not allow you to edit multiple files. Since there is no support for extended memory, large programs cannot be compiled or debugged.

On the positive side, QuickC for DOS will run on the XT class of computers, and an assembler can be optionally included in the package. Also, the project MAKE facility within the IDE generates standard ASCII MAKE files, which can be used from the command line; no conversion is necessary.

QuickC supports ANSI C and Microsoft-extended C, but K&R C is not supported and there is no C++. Error messages are somewhat terse, although the help system provides additional explanation.

Compilation errors are listed in a separate message window. As you move through the list of error messages, the related source code in the edit window is highlighted. But once you move to the edit window, the coordination between the messages and source code is lost; highlighting the error message will no longer bring you

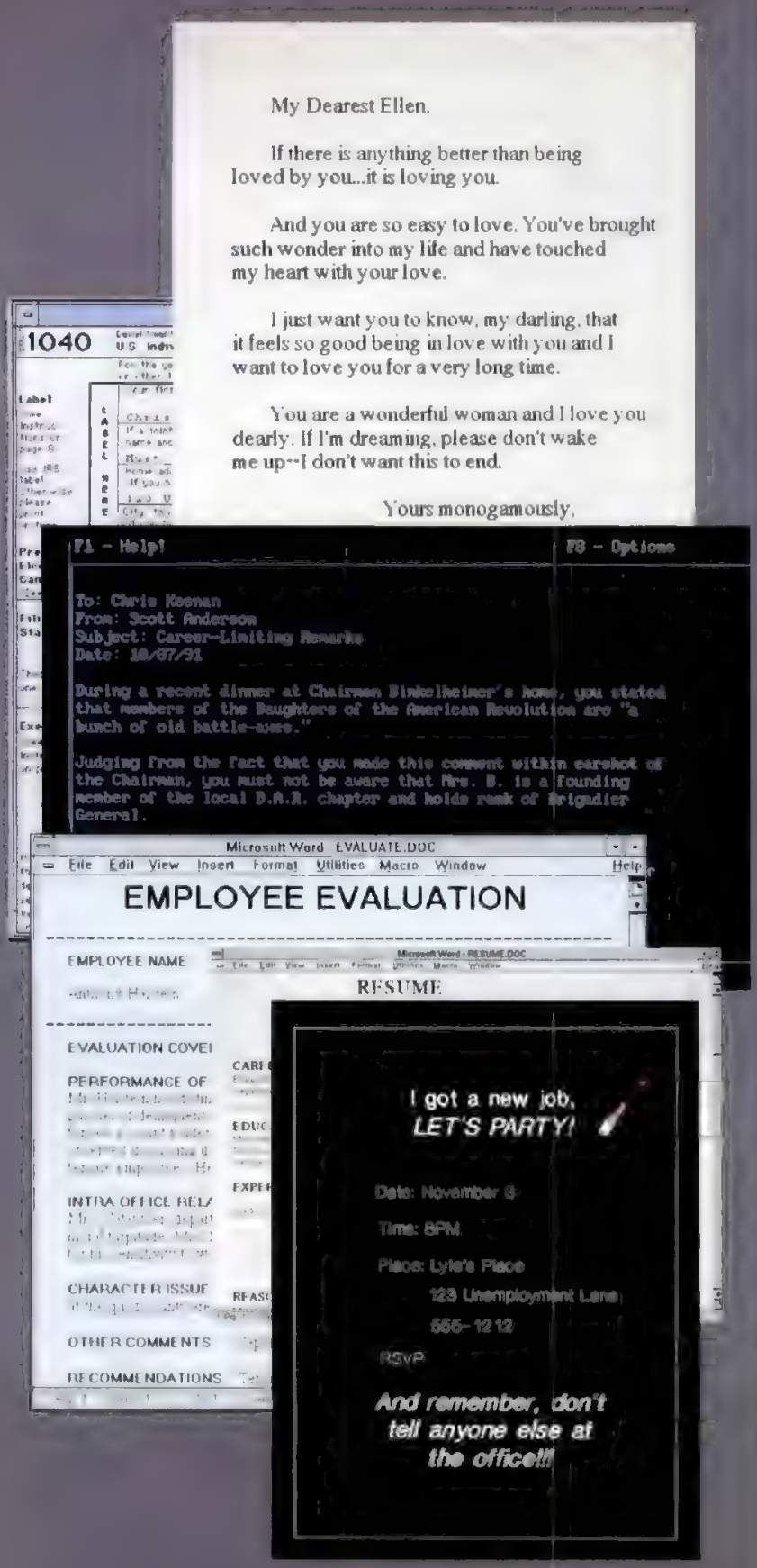
SUITABILITY TO TASK

Microsoft QuickC for DOS

	POOR	FAIR	GOOD	EXCELLENT
Small DOS applications	●	●	●	○
Large DOS applications	●	○	○	○
Windows applications	N/A			
C++ development	N/A			
Portability	N/A			

Turbo C++ for DOS

	POOR	FAIR	GOOD	EXCELLENT
Small DOS applications	●	●	●	●
Large DOS applications	●	●	●	○
Windows applications	N/A			
C++ development	●	●	●	●
Portability	N/A			



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to the relevant source code line, as it does in Turbo C++.

The built-in debugger, which can be used with either C or assembly language code, is integrated almost too well; it is difficult to see when you are in debug mode. Because of the lack of extended memory support, large programs cannot be loaded into the debugger. We were able to load our small DOS test program, but not our large DOS test program.

ENTRY-LEVEL? WHO SAYS!

These packages are both considered entry-level products, but only a few years ago, Turbo C, Version 1.0, served well as a development system for many professionals. The current Turbo C++, Version 3.0, compiler has everything Turbo C, Version 1.0, had and more, and classifying it as an entry-level compiler may do it a disservice. It is perhaps more accurate to describe it as a low-cost alternative.

QuickC isn't up to the standard set by Turbo C++ because of the lack of C++ and extended memory support, the lack of multifile editing, the looser integration between the editor and the debugger, and the lack of a user interface library. When you consider that the two packages are priced the same, it is difficult for us to recommend QuickC unless you have an 8086/8088 computer and no intention of upgrading.

FACT FILE

Turbo C++ for DOS, Version 3.0

Borland International Inc., 1800 Green Hills Rd., P.O. Box 660001, Scotts Valley, CA 95067; 800-331-0877, 408-438-5300; fax 408-439-9100

List Price: $99 95
Requires: 286-based PC or better, 1MB extended memory, minimum 5MB hard disk space, 640K RAM, DOS 3.31 or later; mouse optional

492 ON READER SERVICE CARD

Microsoft QuickC for DOS, Version 2.5

Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080; fax 206-936-7329

List Price: Including compiler, toolkit, and documentation, $99 95, with Quick Assembler, $249
Requires: 512K RAM, 5MB hard disk space, DOS 2 1 or later

491 ON READER SERVICE CARD

Microsoft QuickC for Windows
Turbo C++ for Windows

BY CHARLES PETZOLD

QuickC for Windows and Turbo C++ for Windows are one-box, low-cost entry-level solutions to Windows programming. The only other software you need is Windows itself. Both products feature Windows-based IDEs, on-line documentation for the Windows API (application program interface), resource-editing tools and debuggers.

What you give up by going this low-cost route is a full-blown, optimizing compiler and sophisticated development tools such as profilers. You can neither compile nor debug DOS programs with Turbo C++ for Windows. With QuickC for Windows, you can compile DOS programs, but you can't debug them. To compensate for the lack of DOS support, both packages include libraries for porting DOS-based programs to Windows. Converted DOS programs will run faster than they would within a DOS box, but they will still look like DOS programs.

QUICKC FOR WINDOWS

The QuickC for Windows IDE uses MDI (Multiple Document Interface) windows for working on source-code files. You can define different colors for keywords, identifiers, comments, strings, and numbers. The built-in editor uses standard Windows definitions for cursor keys. However, very little functionality beyond basic editing is provided. For example, you can't define any keyboard macros.

You can use the edit window to type in ASCII resources such as menu or dialog box templates, but to create and edit binary resources or to create a dialog box interactively, you must launch separate programs. Both programs can be invoked

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CCITT V.42bis / MNP 5	√	√
CCITT V.42 / MNP 2, 3 and 4	√	√
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External	√	√
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SUITABILITY TO TASK

Microsoft QuickC for Windows

	POOR	FAIR	GOOD	EXCELLENT
Small DOS applications	●	○	○	○
Large DOS applications	●	○	○	○
Windows applications	●	●	●	○
C++ development	N/A			
Portability	N/A			

Turbo C++ for Windows

	POOR	FAIR	GOOD	EXCELLENT
Small DOS applications	N/A			
Large DOS applications	N/A			
Windows applications	●	●	●	●
C++ development	●	●	●	●
Portability	N/A			

from either the Program Manager or from within QuickC for Windows. The Image Editor lets you create and edit icons, customized cursors, and small bitmaps; the Dialog Editor lets you interactively create and edit dialog box templates. Both tools are identical to those included in the professional version, and they have the same faults; they provide very little beyond minimum functionality.

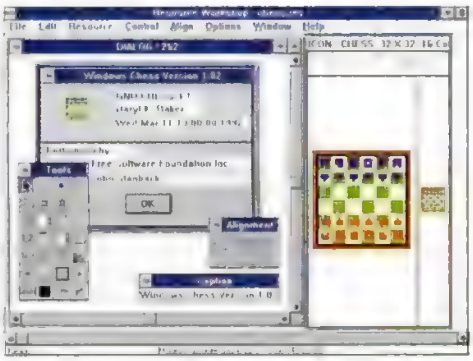
Microsoft's QuickC for Windows also comes with a version of Caseworks's Case:W called QuickCase:W. (This is not included in the professional version of the product.) QuickCase:W lets you interactively design your program's windows and menus, and generates skeleton Windows code that you can edit and enhance. Some beginning programmers may find QuickCase:W to be helpful, but with a little experience, you'll probably find it easier to create templates by modifying existing Windows code. With Quick-Case:W, interactive design can start to feel like more hindrance than help.

The QuickC debugger is so closely integrated with the IDE that you may not realize you're executing code when you press the mysterious "footprint" icon on the IDE toolbar. The debugger provides breakpoints and watch windows, but not much else. It's just about functional enough for beginning Windows programmers, but it is not CodeView; it cannot display machine code, and it cannot help with modules created using languages other than C.

TURBO C++ FOR WINDOWS

On the surface, Borland's Turbo C++ for Windows IDE looks a lot like the Microsoft product, with MDI used for multiple editing windows. But there the similarities cease. The most important difference is that Turbo C++ supports AT&T C++ 2.1 as well as ANSI C. The ObjectWindows Library (OWL) for simplifying Windows programming is included. Another nice feature is the browser, which lists of all the functions, variables and classes in a program, and lets you instantly jump to the source code file that includes the definition.

Like QuickC, Turbo C++ includes a separate program for creating and editing resources: the impressive Resource Workshop, which is also included with the professional product. With it, you can create and edit all types of resources. Even if you prefer to create menu templates interactively, the Resource Workshop is better than the similar feature in QuickCase:W. The Resource Workshop can extract resources from existing Windows executables, dynamic link libraries, and device drivers, and insert new ones back in, a feature missing from QuickC.



Turbo C++ for Windows includes a browser facility, and you can use the MDI (Multiple Document Interface) to work with multiple files. The Resource Workshop lets you edit dialog box templates and icons, as well as many other types of resources.

Turbo C++ for Windows includes a full-featured Windows debugger. Since the debugger interface and your program cannot appear on-screen together, you will either need a second monitor or a high tolerance for screen flipping.

NOT QUITE PERFECT

Ideally, programming tools for a Windows compiler should be integrated in a manner that takes advantage of Windows' features, but neither product achieves this ideal. For example, in QuickC for Windows, you encounter a separate file-open dialog box for the Image Editor, the Dialog Editor, QuickCase:W, and the edit and project windows. There is no reason why a single MDI-based IDE cannot be used for everything, with the main menu, status line, and toolbar changing according to the current task. Even so, these entry-level packages provide impressive functionality at a very low price. For under $200, you can get everything you need to write Windows programs in C.

Which compiler should you choose? In almost every way—the browser facility in the IDE, the support of C++, the extensive Resource Workshop, the Turbo Debugger—Borland's Turbo C++ for Windows clearly outranks Microsoft's QuickC for Windows. It even costs less. If you want to explore Windows programming without investing a lot of money, you can't go wrong with Turbo C++. □

FACT FILE

Microsoft QuickC for Windows, Version 1.0

Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080; fax 206-936-7329

List Price: Including compiler, toolkit, and documentation, $199
Requires: 286-based PC or better, 2MB extended memory, hard disk, EGA display or better, DOS 3.3 or later, Windows 3.0 or later; mouse recommended.

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Turbo C++ for Windows, Version 3.0

Borland International Inc., 1800 Green Hills Rd., P.O. Box 660001, Scotts Valley, CA 95067; 800-331-0877, 408-438-5300; fax 408-439-9100

List Price: $149.95
Requires: 286-based PC or better, 2MB extended memory, hard disk, EGA display or better, DOS 3.31 or later, Windows 3.0 or later; mouse recommended

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Hayes Ultra 144	38.4K		○				
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TCP/IP PACKAGES FOR NETWARE 3.11

Using the Alphabet Soup

Functionality and performance are key factors for TCP/IP packages that run under DOS. The five TCP/IP products reviewed here expand the horizons of your NetWare workgroups by connecting them with Unix hosts and other platforms.

Imagine: You are charged with connecting a NetWare LAN and a dozen different hosts, each with its own unique architecture, each provided by a different vendor. A nightmare? Not necessarily. Thanks to TCP/IP, there's an easy way to connect nearly every computing platform on the market today.

The Transmission Control Protocol/Internet Protocol (TCP/IP) is the de facto standard for interconnecting otherwise incompatible computers. Like NetWare's SPX (Sequenced Packet Exchange) and IPX (Internet Packet Exchange), TCP/IP is a set of network and transport protocols that enable higher-level applications to communicate, but it lacks much of the functionality of a regular network operating system.

While NetWare has emerged as the method for connecting a corporation's PCs, however, TCP/IP has become the tool for giving the users of those PCs access to the corporate data typically residing on a Unix host. Often TCP/IP is the only way for two otherwise incompatible computers to communicate, a key capability in today's ever-growing networks.

One way to retrieve this data is to load TCP/IP alongside the NetWare protocol stack residing in a PC. In this review, we look at five products that perform this task: Beame & Whiteside Software's BW-NFS for DOS, James River Group's ICE .TCP, Novell's LAN WorkPlace for DOS, The Wollongong Group's PathWay Ac-

426 BW-NFS for DOS
428 ICE.TCP
434 LAN WorkPlace for DOS
437 PathWay Access
438 PC/TCP Plus

by Frank J. Derfler, Jr.

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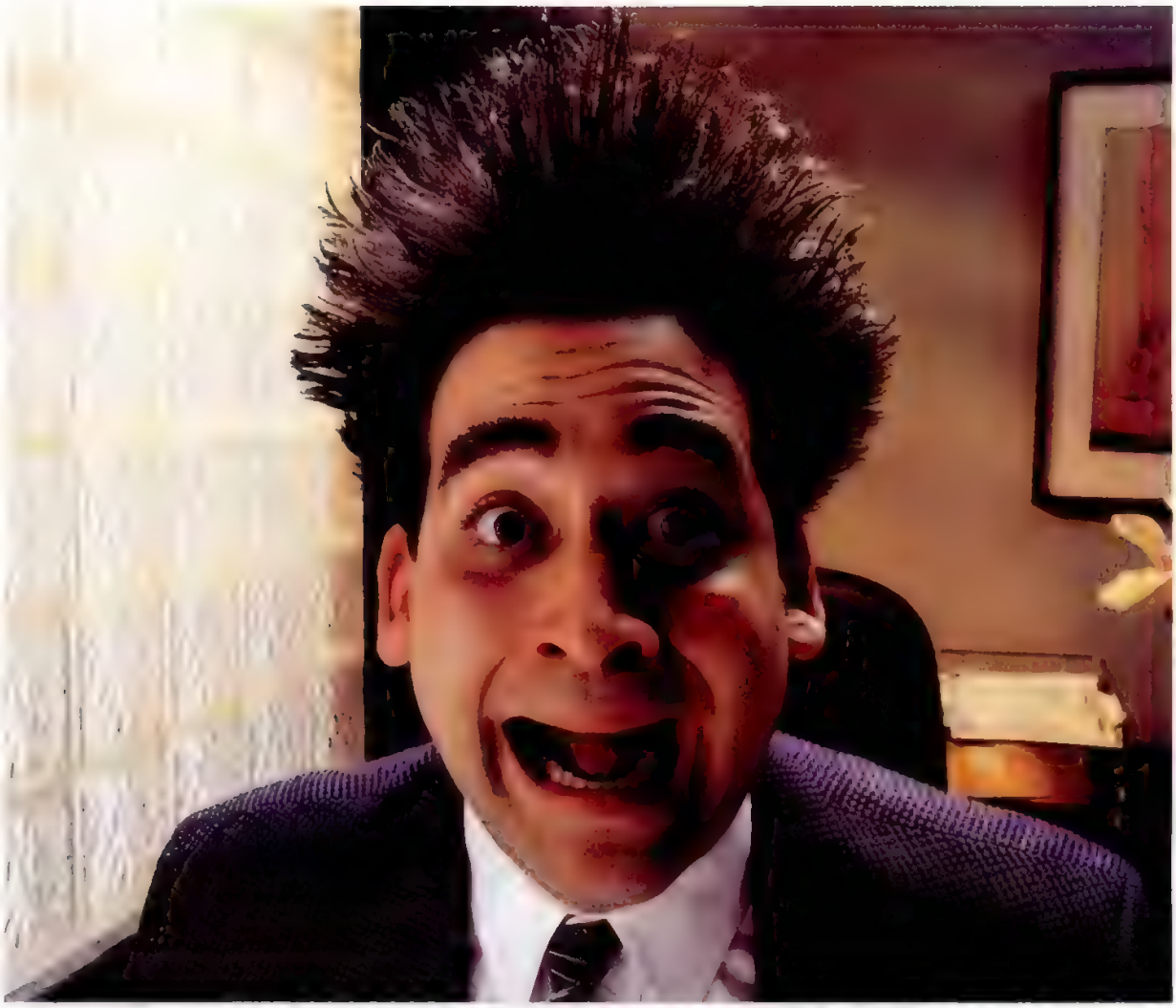

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cess, and FTP Software's PC/TCP Plus.

All of these packages offer basic TCP/IP functions, such as terminal emulation and file transfer. Some come with Microsoft Windows front ends.

Performance in these products hinges on how efficiently they set certain communications parameters between two computers. If users are communicating within a single network and their files are fairly small, however, performance typically will not be a major purchasing criterion with these products.

USING TCP/IP

To the user, TCP/IP appears as a series of applications needed for basic communications. These applications include the Telnet terminal emulation, the File Transfer Protocol (FTP) and its sister the Trivial File Transfer Protocol (TFTP), remote execution utilities, the Simple Mail Transfer Protocol (SMTP), and the Simple Network Management Protocol (SNMP). And by adding the Network File System (NFS) running on top of TCP/IP, a user can obtain much of the simplicity of a standard network operating system.

Telnet is an application that typically emulates a DEC VT100 or VT200 terminal. Some of the packages in this roundup also provide IBM 3270 terminal emulation. The products in this review allow a user to address from 7 to 64 remote computers in simultaneous sessions, a capability best used under Windows.

The Telnet specification has been expanded to include TelAPI, an application program interface that allows emulators (often supplied by other manufacturers) to interface with the Telnet software.

Both FTP and TFTP enable a user to move files between PC-based and Unix systems. The only difference is that TFTP can only move one file at a time. To move a file, users indicate the filename and the address of a computer—the *daemon*—or the computer process (called a "socket" in Unix terminology) that holds the file. The software then works through the lower layers of TCP/IP to deliver the file to the users' PCs.

Some of the products reviewed here simplify FTP usage. PathWay Access allows users to enter file-transfer requests in DOS format from their PC. Under Windows, network managers can assign FTP functions to Windows buttons by using Novell's File Express (included with LAN WorkPlace for DOS).

The remote execution utilities—remote printing utility (RPR), Remote Shell (RSH), and REXEC—make it easier to start programs or issue commands to a computer running Unix. Users are not required to work through Telnet terminal emulation when they run remote execution utilities; they can enter instructions from the DOS command line.

Despite their names, applications such as the Simple Mail Transfer Protocol (SMTP) and the Simple Network Management Protocol (SNMP) are more complex than the other TCP/IP utilities. SMTP is used to move electronic mail between major nodes, but it lacks a high commercial appeal. SNMP, on the other hand, is a big success. Supported by dozens of companies, SNMP management programs run in PCs under Windows and over TCP/IP products such as those in this review (examined in "Wired for Intelligent Management: 10BaseT Hubs and Concentrators," *PC Magazine*, November 12, 1991).

By adding NFS on top of TCP/IP, users can augment these utilities by enabling a PC to address remote disk drives as if they were local. Thus, the NFS-TCP/IP combination provides roughly the functionality of a network operating system, such as LAN Manager, NetWare, or VINES.

All of these different TCP/IP applications typically run over one of two session layer protocols: the Universal Datagram

HIGHLIGHTS

TCP/IP for NetWare 3.11

ORIGINALLY BUNDLED with Unix, the Transmission Control Protocol/Internet Protocol (TCP/IP) is a protocol stack that enables computers from different vendors to exchange information. TCP/IP is equivalent to the ISO protocol stack, which aimed at accomplishing a similar goal; currently, TCP/IP is more widely supported.

TCP/IP STACKS for NetWare run over Novell's device driver specification, Open Data-link Interface (ODI). The five packages reviewed here all offer FTP (File Transfer Protocol) and Telnet support.

ALL OF THE products fared pretty evenly in local performance and in their support for FTP and Telnet. The major differences between these products come in three key areas: the amount of memory the packages consume, their user interfaces, and their internetwork performance.

RUNNING TCP/IP as a stack at each workstation is a good solution for users who need frequent access to a Unix host. Alternatively, you can set up a NetWare-to-TCP/IP gateway for infrequent users. Running a special version of NetWare on the Unix host is another option, but this demands much more memory and does not deliver the performance of native NetWare.

NOVELL'S LAN WorkPlace for DOS offered the best use of the Microsoft Windows interface among the five products we tested. The Windows interface slows down transfers, but LAN WorkPlace for DOS includes a faster implementation that works under DOS.

FTP SOFTWARE'S PC/TCP Plus provided the fastest performance in transferring a file from a DOS client to a Unix host, while The Wollongong Group's PathWay Access gave the best performance for file transfers in the opposite direction. LAN WorkPlace for DOS showed the fastest time in reading an ASCII file from a Unix host on-screen.

BEAME & WHITESIDE Software's BW-NFS for DOS lets you run most TCP/IP-based applications written for other TCP/IP transports without modifying them, even if they were developed for Novell's and FTP Software's products.

ROLL OVER, BOTTICELLI.

"The Birth of Venus," Louis Fishauf, Canada, 1992. Adobe Illustrator for Windows, 34" x 10"

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Protocol (UDP) and TCP, which both run on top of IP. These protocols offer trade-offs between assured delivery and network overhead. TCP contains cast-iron assurance of a packet's delivery, but it is slower than UDP. SNMP, whose operations are not critical, interacts with UDP. FTP, with important data to deliver, uses TCP.

IP is typically implemented in the smallest and least visible software module, but it is key to interplatform and internetwork communications. The IP-formatted packet contains address and data fields (see the diagram "Inside the TCP/IP Frame").

The addressing information identifies the specific station and its network. Each network must use a particular type of address. There are three different types of addresses: Class A, Class B, and Class C. Each varies based on the number of stations and attached networks. Class A addresses are used in networks with few workgroups and many stations, while Class C addresses are used in networks consisting of many workgroups and few stations.

By including the network address with each station address, frames can be efficiently routed between different LANs. The devices making this routing decision are appropriately named *routers*.

TCP/IP CONNECTIVITY OPTIONS

Running a separate TCP/IP stack on each client station is great for users who demand frequent access to the Unix host. But if many users want only infrequent access to Unix machines, a TCP/IP gateway may be the right solution. A number of NetWare-TCP/IP gateways are currently on the market, including the CatIPult from Ipswitch. With a gateway, there is not a protocol stack on each client station and thus no fee for each station. Instead, you provide the software for one PC to convert between the NetWare and TCP/IP environments. Gateways also provide centralized administration and control, important capabilities in a large network.

On the other hand, with gateways, you lose scalability and—potentially—reliability. Using a gateway does not give users the transparent DOS commands they enjoy by loading NetWare on the foreign machine. On-the-fly protocol translation in the gateway can choke under heavy loads, limiting most of these gateways to about 30 concurrent sessions. And by locating all of the TCP/IP connectivity in one box, there is a single point of failure. Should the gateway fail, all users lose their TCP/IP capability.

On-the-fly protocol translation in gateways can choke under heavy loads, which limits most gateways to about 30 concurrent sessions.

Another alternative is to load NetWare onto the TCP/IP host computer. Novell's NetWare for VMS connects NetWare users to Digital computers running the VMS operating system. Digital and Novell announced that they were working on plans to develop new NetWare products for VMS and for Digital's version of Unix, known as Ultrix. Novell has similar development plans with Hewlett-Packard.

Making a computer with a different underlying operating system into a NetWare server has positive and negative aspects. The major advantage is that users can type regular DOS commands to access and move files. In addition, the foreign server usually has a huge file storage capacity. On the negative side, with NetWare running on top of the Unix operating system, performance of the foreign server does not come close to a native NetWare server. NetWare will also require expensive memory and processor power and will add to the workload of system administrators. And while loading NetWare on the foreign server solves the problem for accessing one host, it does not work across the wide variety of platforms served by TCP/IP.

In NetWare 3.11, Novell introduced important TCP/IP capabilities as an integral component of the operating system. For routing TCP/IP frames between networks, Novell provides a series of NetWare Loadable Modules (NLMs). These NLMs can also encapsulate NetWare IPX packets inside IP packets, allowing NetWare 3.11 servers to communicate across a wide area network through the IP protocol (examined in "Network Operating Systems Go Corporate," June 16, 1992).

REVIEW CRITERIA

The products in this review had to support DOS, FTP or TFTP, Telnet, and Novell's Open Data-link Interface (ODI) specification.

BW-NFS for DOS was the only prod-

PC MAGAZINE

EDITORS' CHOICE

• LAN WorkPlace for DOS

Novell's LAN WorkPlace for DOS provides the best Microsoft Windows interface of the packages reviewed here, and its performance, at least under DOS, is competitive with the other products'. Although file transfers take longer under Windows, LAN WorkPlace's ease of use compensates for any speed difference. The $450 program's low memory requirements and its professional, informative documentation are in its favor.

Probably the best-known TCP/IP product is FTP Software's $490 PC/TCP Plus. PC/TCP Plus offers a rich environment for power TCP/IP users. We did not award it an Editors' Choice, however, due to its troublesome installation and poor accompanying documentation.

Our Contributors: FRANK J. DERFLER, JR., is workgroup systems editor of *PC Magazine*. STEVE RIGNEY and M. KEITH THOMPSON are frequent contributors to *PC Magazine*.

uct that offered partial support for FTP. It can act as an FTP client but not as an FTP server. Although NFS was not required in the review, it is included in BW-NFS, PathWay Access, and PC/TCP Plus; we did not test that capability, however.

We feel that for a NetWare network ODI is especially important, since ODI is native to NetWare 3.11. ODI is a driver specification that allows multiple network protocols to use a single adapter. Thus, a PC on a NetWare 3.11 network can typically connect without additional software. (See the sidebar "Packet Driver Specifications: The Heart of TCP/IP for DOS.")

Instead of ODI, 11 vendors use the Network Driver Interface Specification (NDIS), developed by Microsoft and 3Com, to support NetWare and TCP/IP. With NDIS, these vendors map the calls normally made from NetWare to ODI onto NDIS (see the sidebar "TCP/IP and NDIS: A Combination for All Platforms").

TCP/IP TRENDS

Probably the biggest trend in TCP/IP products is Windows support, or the lack thereof. Only Novell's LAN WorkPlace for DOS offers a full Windows interface; the other products provide Windows support to varying degrees. With Windows support, the products can seamlessly integrate the TCP/IP modules.

In general, vendors are taking two approaches to adding TCP/IP support. Virtually all the companies in this roundup provide a reentrant kernel, so that their packages function under a DOS session. With a reentrant kernel, Windows can pause a process, service another request, and return to that process without losing data.

Although effective, running a TCP/IP package under a DOS session can consume a great deal of conventional memory. Some vendors go a step further and build their products as TCP/IP dynamic link libraries (DLLs). As a DLL, the TCP/IP stack can load above conventional memory. Users can also load and unload the DLL from RAM.

Although it is effective, running a TCP/IP package under a DOS session can consume a great deal of conventional memory.

With Windows support, vendors are able to hide a key weakness: the modularity of these products. In some DOS products, for example, users must completely leave the emulation session through a hotkey to get back to DOS. There is no way to perform DOS actions such as inputting a DIR command from within the emulator.

Another area of focus for TCP/IP vendors is application support. Each TCP/IP stack offers a unique application programing interface (API). Developers must therefore write applications to each API. Beame & Whiteside was the first to come up with a solution that enabled its TCP/IP stack to run other vendors' applications. Now Microsoft is leading an informal consortium of about 25 vendors, including Novell, Sun Microsystems, and 3Com, to create Winsock (Windows Socket): a standard that helps programmers create TCP/IP applications and move existing Unix applications to Windows.

Installation of the products in this review was fairly straightforward. Although TCP/IP implements a complex addressing scheme, most of these products were ready to go right out of the box, except for LAN WorkPlace, which requires configuration for an IP address.

Pricing on these packages varies widely. When equipping 100 nodes with TCP/IP, for example, a network license can cost as little as $20 per node. Software for a single node, however, can run $450 to $495 for some products, though others with similar capabilities cost $249 for a single copy.

Finally, while we found that TCP/IP offers tremendous benefits for corporate-wide connectivity, we also found that it exacts a stiff price in the amount of RAM. Together, NetWare and TCP/IP elements can consume nearly 190K of RAM. Alone, TCP/IP stacks may use anywhere from 20K to 70K.

PERFORMANCE

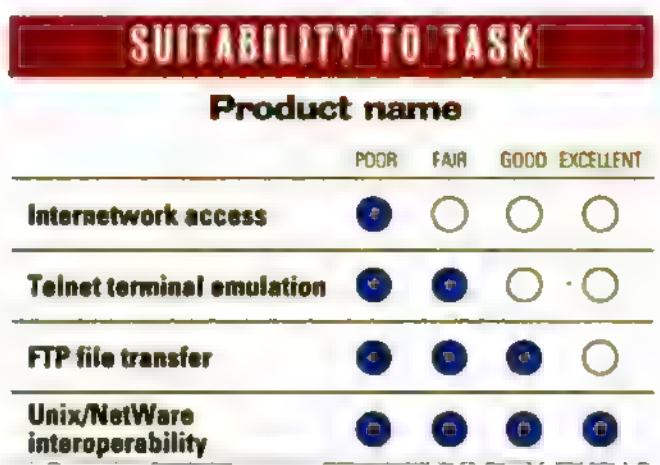
Performance differences among these products were subtle, in part because we were passing a fairly small (10K) file. But if we increased the file size, (say, to several megabytes), used a lower speed

Rating the Products: Suitability to Task

The TCP/IP connectivity needs of NetWare users differ greatly. Some users need access to a wide variety of terminal emulations for interoperating with different types of hosts; others simply want fast file transfers.

Internetwork access represents the product's ability to work across a multiple-router internetwork connection. The product should be able to maintain a connection over long delays, even when the Ethernet connector is unplugged. Ease of installation and connections, as well as protocol robustness, also matter.

Telnet terminal emulation reflects the product's ability to emulate a DEC VT220 workstation using the Telnet virtual terminal protocol. The client should be able to log on to the host and edit files. The variety of terminal emulations offered, the ease of use, and the terminal emulation robustness also count.



FTP file transfer reflects the product's ability to transfer files from DOS client stations to Unix hosts, and vice versa, using the File Transfer Protocol (FTP). Ease of use, robustness, and speed are also taken into account.

Unix/NetWare interoperability scores the product's ability to maintain simultaneous connections with both NetWare and Unix servers and allow users to switch between them easily. Multitasking capability, through interfaces such as Microsoft Windows and DESQview, is a plus.

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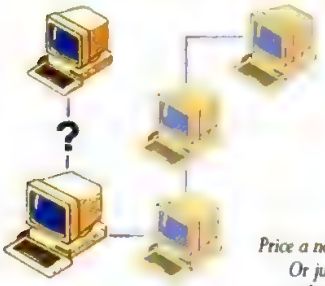

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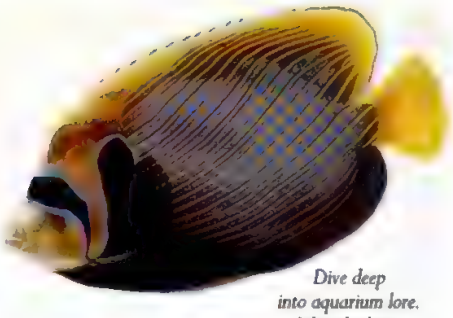

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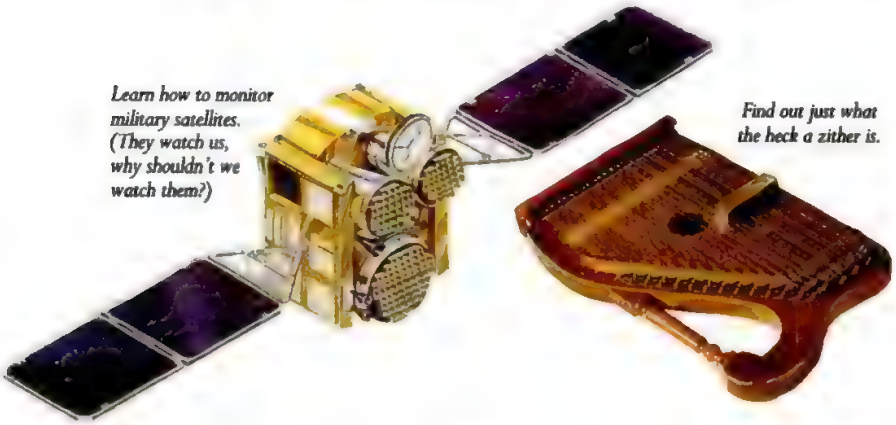

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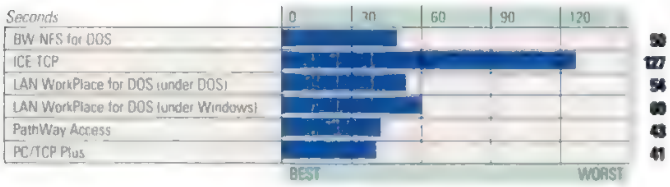
Performance Tests: TCP/IP for NetWare 3.11

The adapter driver and algorithms for congestion control, caching, and packet size negotiation are the major players in optimizing the performance of TCP/IP stacks. Using a product's Microsoft Windows interface can cut down on throughput, but Windows provides distinct advantages in managing multiple sessions.

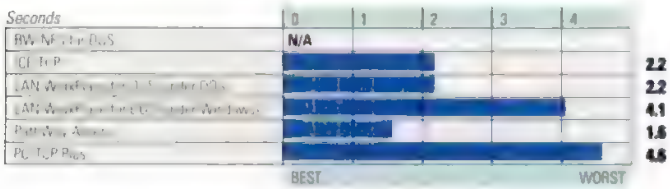
TRANSFER TO THE SUN

The **Transfer to the Sun** test exercises each product's FTP utility and its ability to transfer a 10MB file from the DOS client to the Unix host. As with all of the tests, we measure the times with a stopwatch and run the test three times. The published number is the average of all three times.



TRANSFER TO THE PC

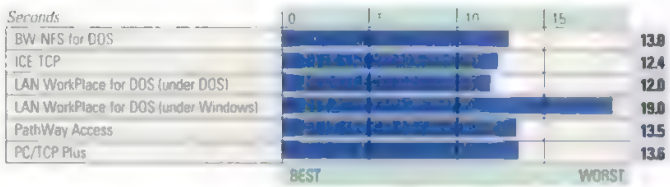
The **Transfer to the PC** test times the transfer of a 100K file from the Unix platform to the DOS platform using the FTP utility.



N/A—Not applicable. BW-NFS for DOS does not support an FTP daemon for the DOS client and could not complete this test

TELNET TIMING

The **Telnet Timing** test measures the time it takes each product to read a 10K ASCII file using the CAT utility. The DOS client uses the Telnet utility to log on from the DOS client to the Unix host remotely.



How We Tested

Our test-bed consisted of one Sun SPARC workstation running the SunOS operating system, Version 4.1, configured as a Unix host. A Compaq 386/25e running NetWare 3.11 acted as the file server. For the DOS client, we used a Compaq 386/25e running DOS 5.0.

Each Compaq had an NE2000 Ethernet adapter installed, and each adapter was connected to a single 10BaseT concentrator. The Sun SPARC workstation had a built-in AUI Ethernet connection and was connected to the same 10BaseT concentrator. During each test, the DOS client attached and logged on to the NetWare server.

On our NetWare server, we selected the "Ethernet_II" frame support option under NetWare to enable both the IPX and TCP/IP products. Each platform used a Class B TCP/IP address during our test. An NE2000 Ethernet adapter and the respective ODI driver were used to connect the PC to the network.

We tested each product in its default mode. Changing parameters, such as buffering and packet sizes, will improve performance in these products.

link (say, 56 kilobits per second), or separated the two hosts with several routers, these minor performance differences would become extremely important (for more information, see "Performance Tests: TCP/IP Packages for NetWare 3.11").

We ran three tests on each product. Two tests measured the time it took to transfer a file from the DOS client to the Sun host, and vice versa, using FTP. Our third performance test looked at the emulation support for the CAT command, a standard Unix command used to view a document on a remote station via a Telnet session, which is similar to the TYPE command in DOS.

On the file-transfer test, FTP's PC/TCP Plus, Beame & Whiteside's BW-NFS for DOS, and The Wollongong Group's PathWay Access exhibited the best performance, thanks to these vendors' focus on optimizing their products' congestion control procedures.

Congestion control refers to the three characteristics that TCP/IP packages need to transfer data.

Congestion control refers to three different low-level characteristics that TCP/IP packages need to consider in order to efficiently transfer data. The first is on-the-fly data compression. The second is the ability to negotiate the packet size during transmission. The PC and the SUN systems must agree on a set packet size in order for them to establish a session.

The third characteristic is that the PC and the SUN must agree on the number of frames that can be sent before requiring an acknowledgment of their receipt by the destination node. FTP Software claims to improve performance of its product by using a special technique to decrease the time needed to arrive at that number of frames.

LAN WorkPlace for DOS (running under Windows) and ICE.TCP both showed poor performance for different reasons. With LAN WorkPlace for DOS, we suspect that the overhead of Windows degraded its speed. We attributed ICE.TCP's performance to its inefficient congestion-control algorithm. James River Group notes that it indeed concen-

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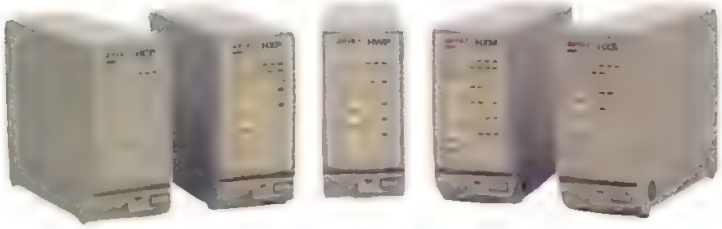

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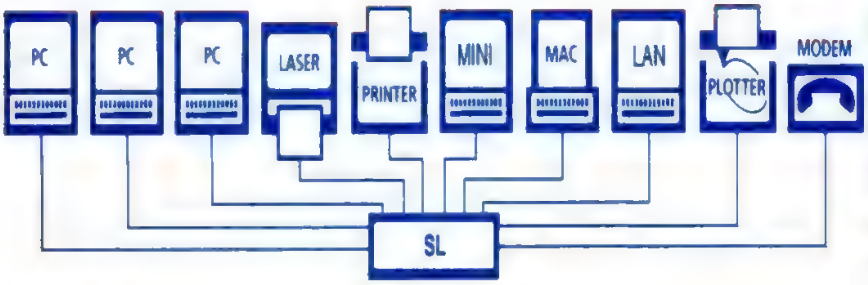

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HXM	2 Ser/ 2 Par	Any Combination	256KB-16MB	$295
HWP	5 Parallel	3/2, 4/1	256KB-16MB	$295
HXP	4 Parallel	2/2, 3/1	256KB-16MB	$245
HCP	2 Parallel	1/1	256KB-16MB	$225
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trated on ease of use and terminal emulation, not performance, in its ICE.TCP product.

On our second performance test, which consisted of transferring a file from a Unix host to a DOS client, PathWay Access, ICE.TCP, and LAN WorkPlace (running under DOS) showed the fastest times. All three products determine the number of requests necessary for transferring the file.

PathWay Access came out ahead of the pack in the test, thanks to a built-in buffering capability that optimizes disk access. Instead of pausing the reception of data to send an acknowledgement, with PathWay Access, the client is able to both receive data and send acknowledgments simultaneously.

BW-NFS for DOS was unable to complete this test because it does not yet support an FTP daemon for the DOS client. In its next revision, this feature should be available.

On our third performance test, the Telnet Timing test, the products' times were similar; the video chip set in the Compaq was the bottleneck. The slowest performer in this terminal emulation test was LAN WorkPlace, while running under Windows. The fastest was LAN WorkPlace running under DOS.

THE FUTURE OF TCP/IP

What lies ahead for TCP/IP? With the emergence of the Government Open Systems Interconnection Profile (GOSIP), TCP/IP vendors may find themselves locked out of one of their largest accounts: the government.

GOSIP is a specification stating that all government networking purchases must comply with or show a long-term migration path to OSI.

Through the Internet Engineering Task Force (IETF), an organization focused on TCP/IP development, TCP/IP vendors are working together to develop that migration path. They are working on IETF specifications, or Requests for Comments (RFCs), for running OSI applications such as the X.400 mail protocol and the X.500 directory services over TCP. But full OSI support is far off. Until that time, NetWare users can gain interoperability between vendors with the TCP/IP packages described in the following reviews.

▶ SUMMARY OF FEATURES

TCP/IP Packages for NetWare 3.11

Since the five products we tested have a lot in common, we compared only their distinguishing features. All of the products support DOS and the following terminal emulations: Telnet and DEC VT100, VT102, and VT220. They also support the character attributes of dim, blink, and color. In terms of protocols, all support Telnet, UDP, ICMP, and ARP.

Products listed in alphabetical order ■ = YES □ = NO	BW-NFS for DOS	ICE.TCP	LAN WorkPlace for DOS (PC EDITORS CHOICE)	PathWay Access	PC/TCP Plus
List price	$349	$245	$450	$490	$490
Maximum simultaneous connections	20	6	64	32	32
Terminal emulation					
ANSI	□	■ (color)	■	□	■
Glass terminal (TTY)	■	□	□	□	□
3270	■	□	□	■	■
Protocol support					
BOOTP (Boot Protocol)	■	■	□	■	■
NFS (Network File System)	■ (proprietary)	□	□	■ (proprietary)	■ (proprietary)
NSP (Network Server Protocol)	□	■	□	□	■
RARP (Reverse Address Resolution Protocol)	■	■	■	□	■
RFC-compliant NetBIOS	□	□	■	■	■
SMTP (Simple Mail Transfer Protocol)	□	□	□	□	■
Additional operating systems supported					
OS/2	□	□	$495	□	$400
Unix	□	■	□	$450	□
Network operating system compatibility					
IBM LAN Server 2.1	■	■	■	□	■
LANtastic	□	□	■	■	■
Microsoft LAN Manager 2.0	■	■	■	■	■
NetWare 3.11	■	■	■	■	■
POWERLan	□	□	■	■	■
VINES 4.11	■	■	■	■	■
Electronic mail support					
X.400	□	□	□	$310*	□
X.500	□	□	□	$310*	□
Mail reader	□	□	□	$310*	■
Domain name lookup	■	■	■	□	□
Uses domain server	■	■	■	■	□
TCP/IP memory consumption					
TSR size	37K	117.4K	19K	25K	70K
Driver memory required	36K	4.1K	24K	10K	3.5K
Can utilize expanded memory	■	■	□	■	□
Can utilize extended memory	■	■	□	■	■

* The $310 price covers all e-mail features, including X.400, X.500 and a mail reader

CONTINUES

▶ SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

	BW-NFS for DOS	ICE.TCP	LAN WorkPlace for DOS (PC EDITORS CHOICE)	PathWay Access	PC/TCP Plus
Remote utilities					
Log-on	■	□	□	■	■
Copy	□	■	■	■	■
Shell	■	□	■	■	■
Print	■	■	■	■	■
Hard disk access	□	■	■	■	■
Backup	□	□	□	□	■
Product can be loaded/unloaded	□□	■■	■■	■■	■■
Mouse support	□	■	■	■	□
Remote boot server	■	□	□	□	□
Network diagnostics supported					
Measures packet loss and delay	■	□	■	■	■
Traces packet path	■	□	□	□	■
Included driver support					
The Clarkson Packet Driver specification	■	■	Available free on NetWire	□	■
NDIS specification	■	■	Available free on NetWire	■	■
ODI specification	■	■	■	■	■
PPP (Point-to-Point Protocol)	□	□	□	□	■
SLIP (Serial Line Internet Protocol)	■	□	□	■	■
X.25 protocol	□	□	□	□	■

ENDS

Beame & Whiteside Software Ltd.

BW-NFS for DOS

BY STEVE RIGNEY

BW-AIA, a new program included in Beame & Whiteside Software's BW-NFS for DOS, Version 2.30, lets you run most TCP/IP-based applications written for other TCP/IP transports. BW-NFS for DOS also provides Telnet emulators, FTP file transfer, NFS support, and basic Microsoft Windows support. Currently, the $349 package does not include a program to make a PC into an FTP server. If you just want a straight TCP/IP package, the company offers BW-TCP, Version 2.30, for $245. Both programs come standard with single-user licenses.

Extremely RAM friendly without sacrificing functionality, BW-NFS for DOS requires only 37K, in addition to the memory needed for the NetWare shell and SPX/IPX. The product could not, however, perform FTP transfers from a Unix host to a DOS client when the request comes from the Unix side. Beame & Whiteside says that it has plans to add this feature soon.

The BW-AIA (Application Interface Architecture) program included with BW-NFS for DOS allows you to run applications developed for any supported TCP/IP transports without modification, including software modules from FTP Software's PC/TCP Plus, Novell's LAN WorkPlace for DOS, and Sun Select's PC-NFS. Architecturally, BW-AIA is a series of small DOS TSRs and Windows 3.*x* dynamic link libraries (DLLs) that you can unload from memory.

BW220, a multisession terminal emulator, allows your IBM PC or compatible computer to function like a DEC VT220, VT100, or VT52, or IBM 3270 terminal. The BW220 emulator includes full international character and keyboard support, keyboard mappings, and definable screen colors.

Unlike LAN WorkPlace for DOS, BW-NFS for DOS does not include specific Windows applications, but like PC/TCP Plus, BW-NFS for DOS users can take advantage of any mapped drives and redirected printers from within Windows. The program also supports NDIS.

BW-NFS for DOS does not currently include e-mail capabilities, though it does work with Sun's LifeLine Mail and other products. BW-NFS for DOS also includes remote utilities, such as log-on, copy, shell, and print.

Installing BW-NFS for DOS is not a very complicated procedure, and the documentation includes thorough installation instructions. The manual's biggest drawback is that it skimps on TCP/IP information in favor of NFS.

Inexpensive and capable, BW-NFS for DOS does not contain some important features, such as an FTP server. But its simplicity and strong application support make BW-NFS for DOS a strong contender in this category.

SUITABILITY TO TASK

BW-NFS for DOS

	POOR	FAIR	GOOD	EXCELLENT
Internetwork access	●	●	●	○
Telnet terminal emulation	●	●	●	●
FTP file transfer	●	●	●	●
Unix/NetWare interoperability	●	●	●	○

FACT FILE

BW-NFS for DOS, Version 2.30

Beame & Whiteside Software Ltd., P.O. Box 8130, Dundas, Ontario, Canada L9H 5E7; 416-765-0822; fax 416-648-6558

List Price: $349, without NFS, $245
Requires: Network card with driver that complies with the ODI, NDIS, or Clarkson Packet Driver Collection specification, DOS 3.1 or later
In Short: BW-NFS for DOS offers support for virtually all TCP/IP applications and low RAM consumption for a moderate price. The version we looked at lacks an FTP server and support for Microsoft Windows, both these features will be addressed in future releases

462 ON READER SERVICE CARD

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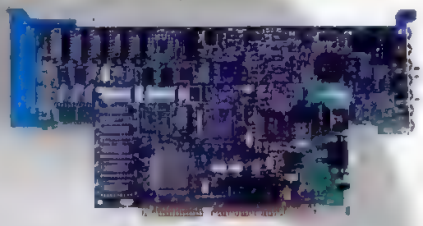

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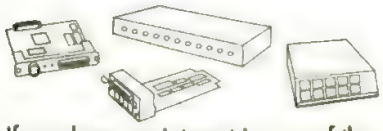

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CIRCLE 185 ON READER SERVICE CARD

James River Group

ICE.TCP

BY M. KEITH THOMPSON

James River Group's ICE.TCP, Version 2.0, brings the flavor of DOS to Unix, providing the best integration with Unix over TCP/IP. Although the package is a little short on standard Unix features and slow in file-transfer performance, the $245 program offers users excellent functionality and ease of use at a good price.

Unlike the other programs reviewed here, ICE.TCP does not just make Unix utilities work on a DOS computer. Its clever FTCOPY program resides on a Unix host and lets you copy files as if from the DOS prompt while connected to the

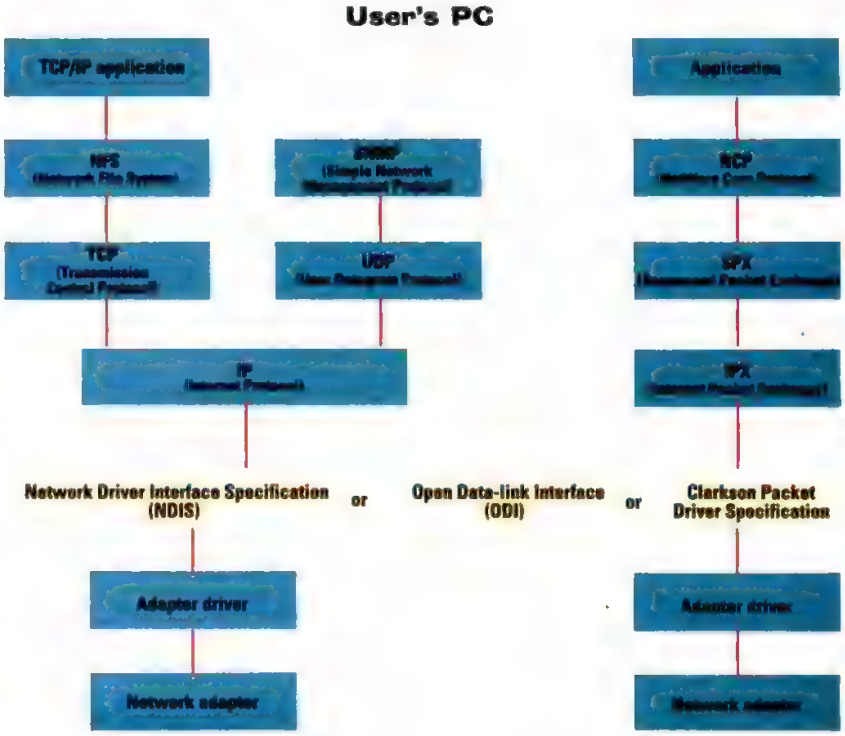
SUITABILITY TO TASK

ICE.TCP

	POOR	FAIR	GOOD	EXCELLENT
Internetwork access	●	●	●	●
Telnet terminal emulation	●	●	●	○
FTP file transfer	●	●	●	●
Unix/NetWare interoperability	●	●	●	○

Packet Driver Specifications: The Heart of TCP/IP for DOS

The key to running multiple protocols in a single PC lies in device driver standards, such as the Network Driver Interface Specification (NDIS), the Open Data-link Interface (ODI), and the Clarkson Packet Driver Specification. Each of these standards establishes a layer of software between the adapter's driver and the network protocol (in this case IP or IPX). The software acts as a traffic cop, directing packets to the appropriate adapter or protocol stack.



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"Carbon Copy's ease of use belies its power and flexibility." *Mobile Office*

3. Best Value

"If you are looking for a remote control program that can handle both asynchronous and LAN operation, then Carbon Copy Plus is far and away the value leader." *PC Sources*

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4. Best Seller

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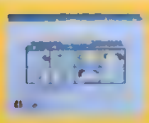
Over 64 weeks on Merisel's best seller list
PC Magazine's Pipeline Top 15

Over 800,000 copies sold

5. Most Platforms

- DOS
- Windows
- Macintosh



"Carbon Copy for Windows is the closest thing to having remote control built into Windows itself." *Windows Magazine*

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Reader's News BENCHMARKS BUYER'S CHOICE

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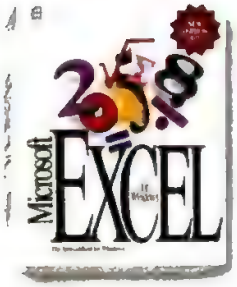

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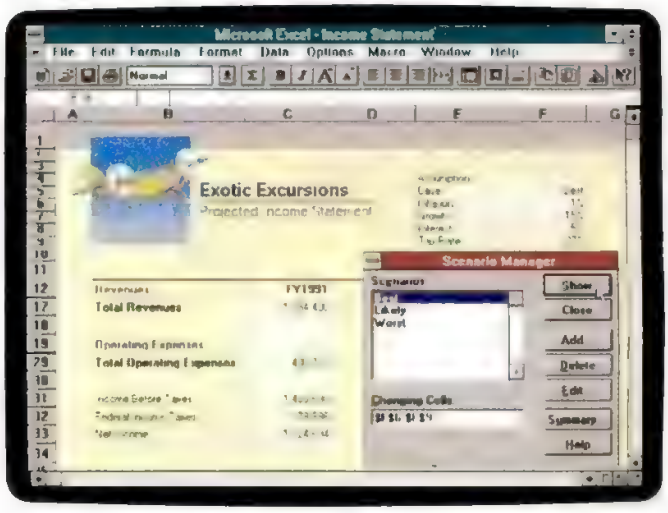

The Scenario Manager is a powerful analysis tool that lets you easily create and save multiple "what if" scenarios, then instantly produce nice-looking summary reports. (Which makes you look nice, too.)

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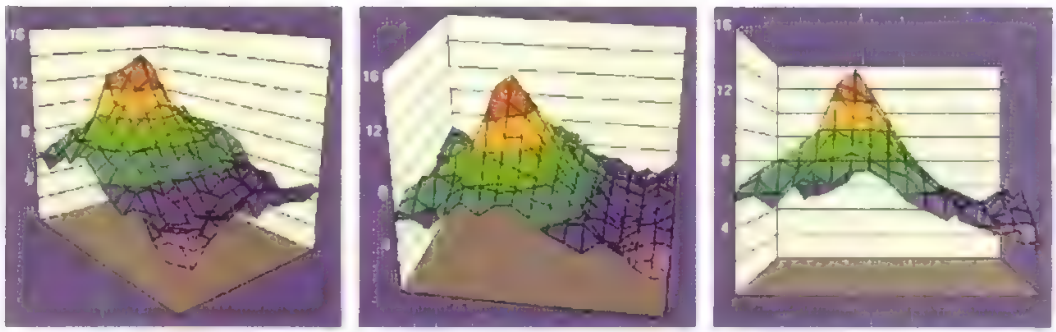
drop it to wherever you want it on your screen. It's that simple.

We've also made the Toolbar customizable. Plus, it has handy new features, such as a Spelling Checker and AutoCenter, which lets you center text over multiple columns with a single click of your mouse.



The gallery of 90 chart types includes rotating 3-D charts, along with surface, radar and picture charts. It looks great here. It's even more impressive on your screen.

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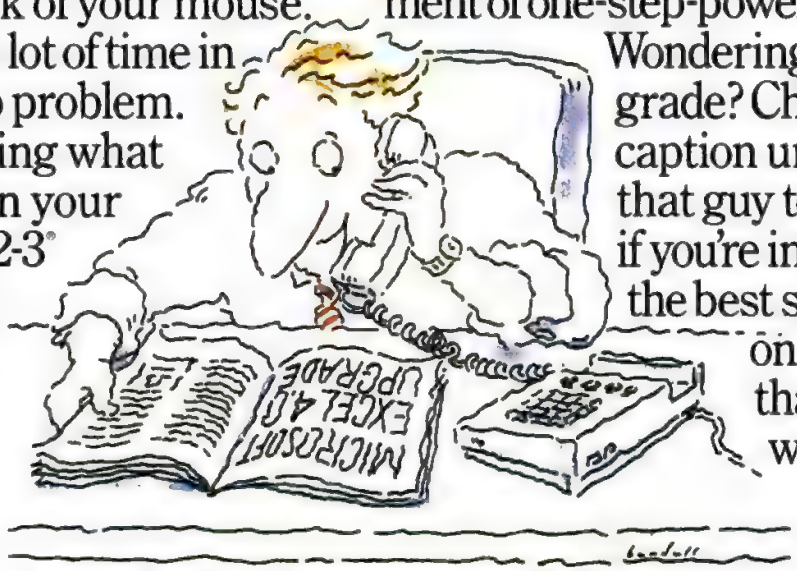

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CIRCLE 254 ON READER SERVICE CARD

ICE.TCP, Version 2.0

James River Group, 125 N. First St., Minneapolis, MN 55401; 612-339-2521; fax 612-339-4445

List Price: $245.
Requires: Network card with driver that complies with the ODI, NDIS, or Clarkson Packet Driver Collection specification; DOS 3.3 or later.
In Short: A simple and easy-to-use product, ICE.TCP offers DOS-like features for Unix computers. Priced competitively, ICE.TCP provides excellent functionality and a wide range of terminal emulations.

466 ON READER SERVICE CARD

host via Telnet. With the other products, you have to exit Telnet and run FTP to transfer files. The product's emphasis on simplicity rather than performance showed on our file-transfer tests, however, where it fell behind Beame & Whiteside Software's BW-NFS for DOS, The Wollongong Group's PathWay Access, and FTP Software's PC/TCP Plus.

Dshell, a DOS command shell, also makes using Unix easy. The Unix machine displays a DOS-like prompt and understands most DOS commands. Dshell also executes Unix commands.

ICE.TCP's emphasis on simplicity showed on our file-transfer tests.

While ICE.TCP uses more memory than its peers, you can load the program in expanded or high memory with DOS 5.0. The device driver uses 4.1K of memory, TCP/IP and Telnet consume 117.4K, and the DEC VT220 terminal emulator takes another 50.9K. You can make as many as seven simultaneous connections.

ICE.TCP does not implement FTP, but rather uses the subset TFTP. Although TFTP cannot send and retrieve multiple files, James River Group allows you to copy multiple files with the much easier FTCOPY.

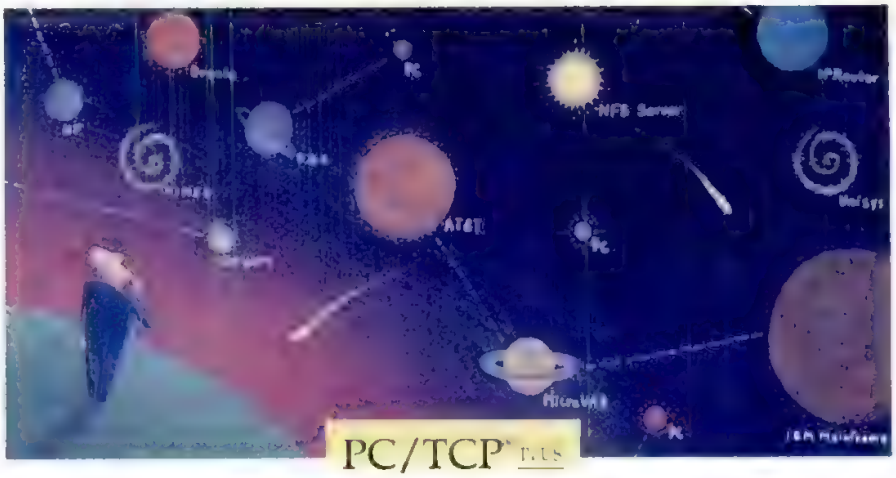
The Telnet implementation provides a wide range of terminal emulations: DEC VT100 and VT220, ANSI, TTY, Wyse, and AT&T. The program does not include e-mail features, although it supplies NDIS and ODI drivers, along with remote log-on, copy, and print utilities.

While James River Group does not currently offer a Windows program, ICE.TCP includes a .PIF file, and its utilities work fine in DOS sessions under Windows. James River Group is also working to provide a Windows product.

James River Group offers multiple-user licensing in Version 2.0, which includes a TSR and Unix printing capabilities. A 10-user license retails for $995, 25-user for $1,995, and 100-user for $4,995.

Installation took only a few minutes. ICE.TCP works well and brings the simplicity of DOS to the Unix world. A competitive price, complete terminal emulations, and ease of use make ICE.TCP a good choice.

There's only one way to get around out here.



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CIRCLE 031 ON READER SERVICE CARD

Inside the TCP/IP Frame

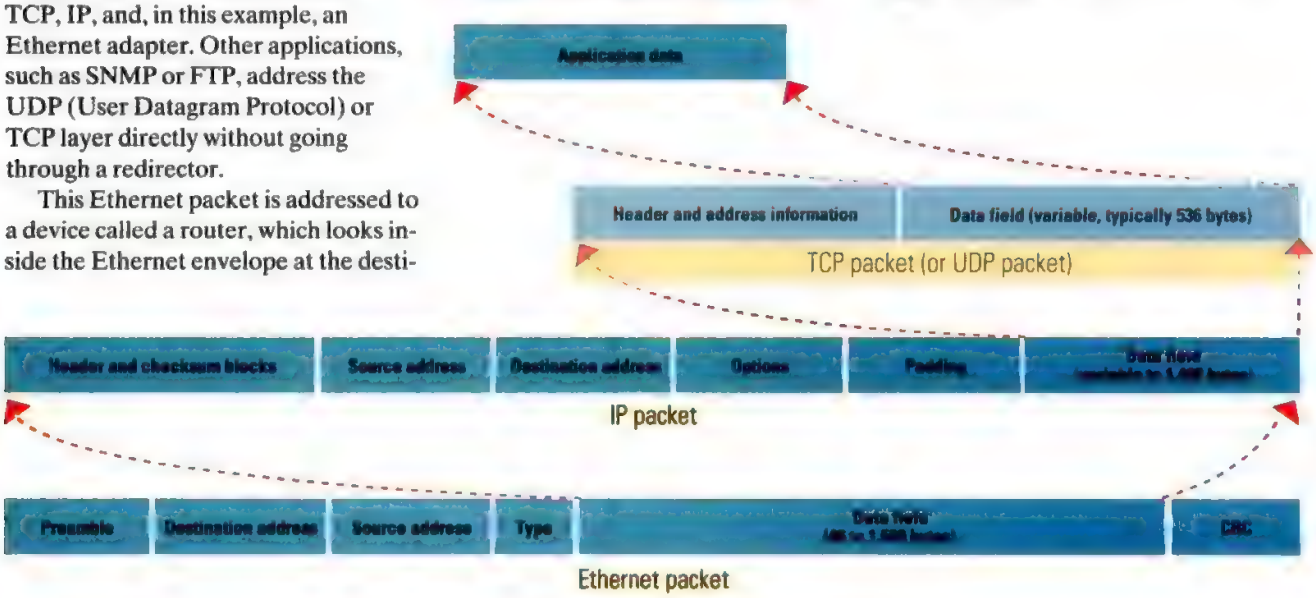
by Frank J. Derfler, Jr.

In a large network, the TCP/IP combination acts like one of the finely tuned addresses read by the local mail room. Application programs typically generate data or requests for services carried in TCP/IP envelopes. Some applications address DOS and are routed through DOS—if a Network File System (NFS) redirector is present—to TCP, IP, and, in this example, an Ethernet adapter. Other applications, such as SNMP or FTP, address the UDP (User Datagram Protocol) or TCP layer directly without going through a redirector.

This Ethernet packet is addressed to a device called a router, which looks inside the Ethernet envelope at the destination of the IP packet and determines the best path to that destination. The diagram shows the structure of the Ethernet packet and the IP and TCP packets it contains.

The Ethernet packet includes a preamble, which helps with synchronization; a type field, which specifies the protocol employed by the data field; a data field containing the IP packet; and a cyclic redundancy check (CRC), which helps ensure data transfer reliability.

The IP packet includes header and checksum blocks, which ensure transfer reliability; an options field, which vendors can set for their own purposes; padding to extend the header to the proper length; and a data field containing the TCP packet.



Novell Inc.

LAN WorkPlace for DOS

BY STEVE RIGNEY

When you are integrating NetWare with TCP/IP, Novell's LAN WorkPlace for DOS is an obvious solution. Priced at $450 for a single-user license, Version 4.01 provides DOS and Microsoft Windows users with direct, concurrent access to Unix systems and NetWare servers.

In testing under Windows, LAN WorkPlace for DOS slowed down when transferring files between DOS clients and Unix hosts. Under DOS, it performed better, thanks to its on-the-fly compression.

One of the most attractive features of LAN WorkPlace for DOS is the amount of memory used: Only 19K of RAM are required for TCP/IP.

Unlike the other packages in this review, LAN WorkPlace for DOS encapsulates NetWare's native SPX/IPX in UDP/IP, giving users the ability to log on to Unix and NetWare servers without needing ODI. The program does not come with an NDIS driver. It also requires configuration for an IP address.

Support for Windows 3.*x* is one of LAN WorkPlace for DOS's best features. Through File Express, Novell's implementation of FTP, Windows users can display a directory listing of all files on the host and transfer them with the click of a mouse button. The product is not optimized for Windows 3.1.

Another Windows application, Serving FTP, works as a Windows-based FTP daemon, allowing your PC to act as an

SUITABILITY TO TASK

LAN WorkPlace for DOS

	POOR	FAIR	GOOD	EXCELLENT
Internetwork access	●	●	●	●
Telnet terminal emulation	●	●	●	○
FTP file transfer	●	●	●	○
Unix/NetWare interoperability	●	●	●	●

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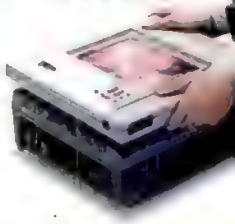

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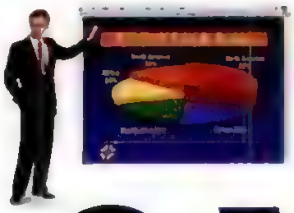

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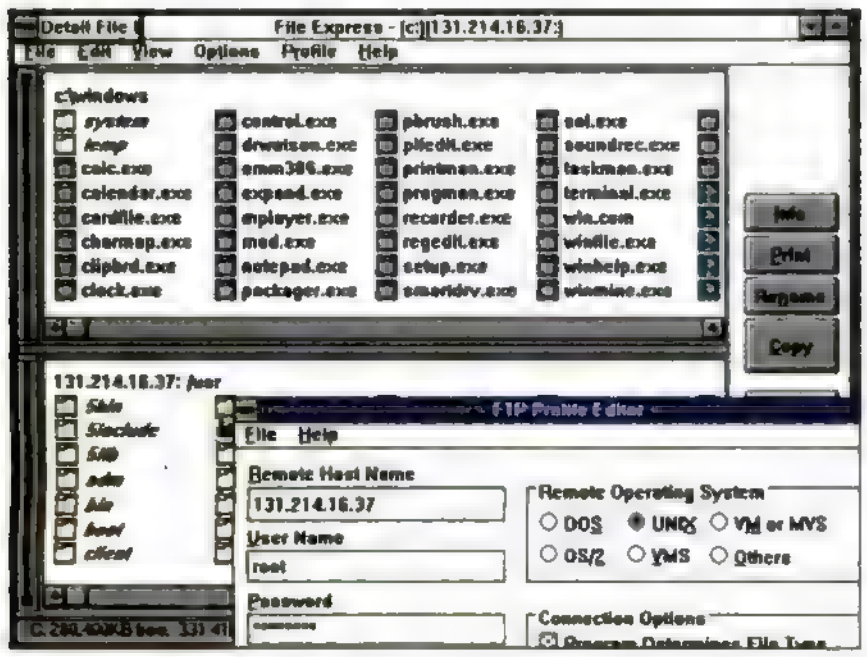

Novell's LAN WorkPlace for DOS provides an attractive Microsoft Windows interface that gives you access to its File Express file-transfer utility and a profile editor that allows you to configure your FTP options.

FTP server to other FTP clients. LAN WorkPlace for DOS includes Windows drag-and-drop and dynamic link library support.

The software also contains a program called Host Presenter that accomplishes Windows terminal emulation by providing up to ten Telnet session windows. It can closely emulate a DEC VT220, VT52, or VT100 terminal, but it cannot emulate an IBM 3270. Host Presenter supports most international character sets and includes an extensive script language that you can use to remap the keyboard or automate sessions.

In addition to Windows applications, Novell's LAN WorkPlace for DOS includes conventional DOS TCP/IP services. The Telnet Application Programming Interface (TelAPI) provides the Telnet engine for third-party terminal emulators.

LAN WorkPlace for DOS includes its own RFC-compliant NetBIOS, but it uses Beame & Whiteside's NFS. LAN WorkPlace for DOS also provides X.400 and X.500 e-mail support, a mail reader, and remote log-on, copy, shell, print, and delete utilities. In addition, Novell offers Macintosh and OS/2 versions of LAN WorkPlace.

LAN WorkPlace for DOS, Version 4.01

Novell Inc., 122 E. 1700 South, Provo, UT 84606-6194; 800-526-5463, 408-434-2300; fax 801-429-5775, 408-435-1706

List Price: $450, LAN WorkPlace for OS/2, $495
Requires: Network card with driver that complies with the ODI specification, DOS 3.3 or later
In Short: LAN WorkPlace for DOS provides excellent TCP/IP connectivity for DOS or Microsoft Windows. LAN WorkPlace is easy to use and provides FTP file transfers and a host of Telnet terminal emulations.

An extremely user-friendly program, LAN WorkPlace for DOS installed quickly during our tests, thanks to its excellent documentation. Novell's LAN WorkPlace is a powerful product whose Windows support and ease of use contribute to its success.

▶ ALTERNATIVE PRODUCTS: SUMMARY OF FEATURES

TCP/IP and NDIS: A Combination for All Platforms

COMPILED BY CATHERINE KUNKEMUELLER

Products listed in alphabetical order by company ■ = YES □ = NO	TCP/2 for DOS	Super-TCP for Windows	Hughes ProLINC 2.0	IBM TCP/IP Version 2.0 for DOS	Chameleon	TCP/IP Protocols
Company	Essex Systems Inc.	Frontier Technologies Corp.	Hughes LAN Systems Inc.	IBM Corp.	NetManage Inc.	Racal Datacom
Phone	508-532-5511	414-241-4555	415-966-7300	800-426-2255	408-973-7171	800-526-8255
Fax	508-531-5541	414-241-7084	415-960-3738	303-440-1639	408-257-6405	508-263-8655
Version of NDIS supported:	2.0	2.0	2.0	2.0	2.0	2.0
Network operating systems supported:						
LAN Manager	■	□	■	□	■	■
NetWare	■	■	■	■	■	□
VINES	■	■	■	□	■	■
Version of Microsoft Windows supported:	3.0	3.1	3.1	3.0	3.1	3.1
DOS application under Windows	■	■	■	■	□	■
DLL (dynamic link library)	□	■	□	□	■	□
TSR	□	□	■	□	□	□
Price range:						
Single-user version	$375.00	$495.00	$450.00	$200.00	$400.00	$395.00
100-user version (per user)	$290.00	$198.00	$200.00	$180.00	$170.00	$130.00
Minimum RAM required	4K	13K (Windows), 77K (DOS)	72K	45.5K	6K (of base memory)	70K
Included with kernel:						
TCP	■	■	■	■	■	■
IP	■	■	■	■	■	□
NFS	■	$95	■	$125	□	$90

The Wollongong Group Inc.

PathWay Access

BY M. KEITH THOMPSON

Microsoft Windows and DOS users have a solution for both environments with The Wollongong Group's PathWay Access. Along with Windows support, PathWay Access packs a broad range of emulations and IP encapsulation with low memory requirements. But at $490 for a single-user license, PathWay Access, Version 2.0, is fairly pricey.

On our tests, the program showed the fastest time on transfers from the Unix host to the DOS client. PathWay uses buffering to optimize data flow.

PathWay Access wins the contest for the least amount of RAM required by using only 10K for drivers and 25K for the terminal-emulating TSR without sacrificing functionality.

The program contains a wide variety of network driver support, including NDIS and the Clarkson Packet Driver specification. PathWay also includes a complete set of R utilities for performing remote operations. PathWay Access supports up to 32 simultaneous connections to hosts under Windows or up to 5 under DOS. The DOS program lets you hotkey between them.

PathWay Access's Telnet utility allows you to hotkey out to DOS and still keep the connection alive. The FTP daemon utility allows files to be transferred in both directions. As with some of its competitors, FTP operates in the background, but unlike the others, it supports concurrent Telnet and lineprinter applications.

SUITABILITY TO TASK

PathWay Access

	POOR	FAIR	GOOD	EXCELLENT
Internetwork access	●	●	●	●
Telnet terminal emulation	●	●	●	●
FTP file transfer	●	●	●	○
Unix/NetWare interoperability	●	●	●	●

With the optional WIN/Route for DOS product, PathWay Access can utilize protocol encapsulation to forward TCP/IP packets between LANs by encapsulating IP within IPX packets.

On the terminal side, PathWay Access offers an average number of emulators. PathWay Access's most feature-filled emulations include all of the DEC VT models and IBM 3270.

At no extra cost, The Wollongong Group provides a Windows implementation. The Windows product works well, but although it supports dynamic link libraries, it needs to take better advantage of the Windows interface.

The program includes SMTP (Simple Mail Transfer Protocol). The NFS protocol lets you transfer files to and from the host transparently. Wollongong's $310 WIN/MHS for Unix supports other e-mail features such as X.400 and X.500.

Installation could be more user friendly, but it is not difficult. Although we would like to see a better use of the Windows interface, The Wollongong Group's reputation for reliable products and quality technical support are definite advantages. In addition, PathWay Access's IP encapsulation capabilities provide a useful bonus for internetwork connections.

AIR for Windows	PC-NFS 4.0	3Com TCP with Demand Protocol Architecture	Net/One TCP BNS/PC	TCP Connection
Spry Inc.	Sun Select	3Com Corp.	Ungermann-Bass Ltd.	Walker Richer & Quinn Inc.
206-286-1412	508-671-0596	800-638-3266	800-777-4526	800-872-2829
206-286-1722	508-671-0049	408-764-5001	408-970-7337	206-322-8151
2.0	2.0	2.0	2.0	2.0
■	□	■	■	■
■	■	■	□	■
■	■	□	■	■
3.1	3.1	3.0	3.1	3.1
□	■	□	■	■
□	■	■	□	□
■	□	□	■	■
$275.00	$345.00	$350.00	$150.00	$199.00
$69.95	$295.00	$99.95	$30.00	$120.00
30K	65K	27K	120K	85K
■	■	■	■	■
■	■	■	■	■
$275	■	$175	□	□

PathWay Access, Version 2.0

The Wollongong Group Inc., 1129 San Antonio Rd., Palo Alto, CA 94303; 800-872-8649, 415-962-7100; fax 415-969-5547

List Price: $490, without NFS $395 WIN/TCP for Streams, $450, WIN/MHS for Unix, $310, WIN/Route for DOS, $149

Requires: Network card with driver that complies with the ODI, NDIS, ASI or Clarkson Packet Driver Collection specification, DOS 3.3 or later

In Short: A tried and proven TCP/IP implementation, PathWay Access provides PC users with the necessary tools to connect to and utilize Unix hosts. PathWay Access includes both the DOS and Microsoft Windows versions in one package.

FTP Software Inc.

PC/TCP Plus

BY STEVE RIGNEY

FTP Software is known for its solid TCP/IP products. PC/TCP Plus, Version 2.05, is one of them; it offers good performance and connectivity with up to ten host Unix and IBM 3270 sessions from a DOS client PC.

Retailing for a pricey $490 per user, PC/TCP includes Telnet terminal emulation and FTP file transfer. The installation and documentation, however, need improvement. While this defect is worth noting, more important is that the product is functional and useful. FTP Software also sells an OS/2 version of PC/TCP for $400.

One of PC/TCP Plus's strongest points is its emphasis on standards compliance. FTP Software claims to meet more RFCs than any other vendor.

One of the product's drawbacks is that it uses more memory—70K—than any of the other products that we reviewed in this issue. FTP Software says this may be because it uses larger packet sizes. The version of PC/TCP Plus we tested supports Windows, but it did not include a Windows interface. FTP Software plans to add the feature this summer.

A drawback of PC/TCP Plus is that it uses more memory—70K—than any of the other products we reviewed here.

PC/TCP Plus bundles several file-transfer programs, including FTP and TFTP utilities, as part of the standard package. RCP, which is the Berkeley Unix remote copy program, copies files to and from a BSD (Berkeley Software Distribution) Unix system.

SUITABILITY TO TASK

PC/TCP Plus

	POOR	FAIR	GOOD	EXCELLENT
Internetwork access	●	●	●	○
Telnet terminal emulation	●	●	●	○
FTP file transfer	●	●	●	●
Unix/NetWare interoperability	●	●	●	○

FTP Software's Telnet provides user authentication and supports up to 32 simultaneous connections. You can switch between sessions or exit temporarily to DOS without logging off the host. FTP's Telnet should work the same as any Telnet terminal. PC/TCP Plus supports most international character sets and lets you remap your keyboard. PC/TCP Plus's Telnet functions provide emulators for the DEC VT52, VT100, and VT220, and IBM 3278 (an offset of the 3270 line of emulators for IBM mainframes). PC/TCP

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CIRCLE 191 ON READER SERVICE CARD

Plus also supports several third-party emulators.

PC/TCP Plus's Interdrive version of the NFS protocol provides transparent access to DOS programs stored on NFS servers, letting you mount remote drives. Its feature set, while not outstanding is certainly on a par with other vendors' NFS implementations.

PC/TCP Plus also includes an e-mail reader feature, along with remote log-on, copy, shell, and print utilities.

PC/TCP Plus includes an e-mail reader feature, along with remote log-on, copy, shell, and print utilities.

PC/TCP's installation was confusing. The package we received did not include ODI drivers, and the manual did not mention their whereabouts. We finally downloaded the ODI patch, but the installation software did not tell us it would not write over existing files. It took several calls to technical support to get the right sequence of installation steps. The PC/TCP Plus package does come with an NDIS driver, however.

Despite these problems, PC/TCP performed well and lived up to its high reputation.

FACT FILE

PC/TCP Plus, Version 2.05

FTP Software Inc., 338 Main St., Wakefield, MA 01880; 617-246-0900; fax 617-246-0901

List Price: $490; PC/TCP Network Software for DOS (without NFS), $400, PC/TCP for OS/2, $400.
Requires: Network card with driver that complies with the ODI, NDIS, or Clarkson Packet Driver Collection specification; DOS 2.0 or later.
In Short: FTP Software is a leader in the TCP/IP world, for good reason. Although the installation and documentation are lacking in depth, PC/TCP Plus offers good FTP performance, excellent Telnet emulations, and support for more Request for Comments (RFCs) than any other vendor.

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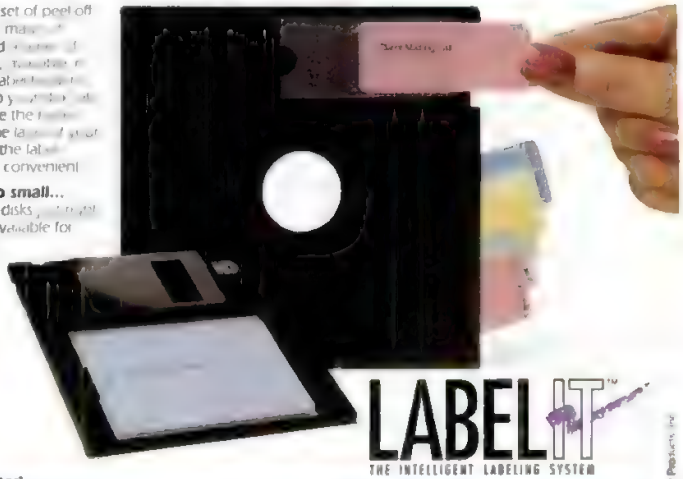

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UTILITIES

Take Control of Your Windows Installations with INCTRL

BY NEIL J. RUBENKING

Installing today's Windows applications is easy: With one command the program's installation utility copies all the necessary files and drivers to your hard disk, makes any needed changes to WIN.INI or SYSTEM.INI, and (typically) adds the new program to a Program Manager group.

But what happens if you later want to *uninstall* an application? Since software publishers can't conceive that anyone would ever want to remove their product after trying it, don't expect them to supply a deinstallation utility. Getting rid of the program icon or group from the Program Manager is easy enough, but you usually don't know just which files were added to your disk and just what changes were made to WIN.INI. You've lost control of what's on your system.

This issue's utility puts you back in charge. INCTRL, the Installation Control program for Windows, supervises an application's install utility and writes a report file that specifies:

- added files and directories;
- changed files (a different size or date/time stamp);
- deleted files and directories;
- new sections in WIN.INI and SYSTEM.INI;
- new keys in WIN.INI and SYSTEM.INI; and
- changed keys in WIN.INI and SYSTEM.INI.

Armed with this written report, you can easily undo the changes made by any install program.

My intention was to design INCTRL so that it would automatically uninstall any program whose installation it had supervised. It would thus delete any added files, remove any new sections and keys from the INI files, and restore the previous value of any changed keys. Unfortunately, however, an automated approach turned out not only to be incredibly complicated, but a bad idea as well.

Suppose, for example, that during its installation Program X copies a support library, FOO.DLL, to your disk. Sometime later you have occasion to load Programs Y and Z, which happen to require the same support library. Y and Z won't install FOO.DLL, of course, since they find that it's already present. But if INCTRL automatically deleted all the files installed by program X, Programs Y and Z would mysteriously be disabled without your knowledge. This is only one aspect of a complicated problem, but it was enough to convince me it was better to produce a report that you can use in making your own deletion decisions.

Uninstalling Windows apps can leave your system full of changes and files you don't know about. Here's how to make sure you get rid of them all.

You can get a copy of INCTRL.EXE by downloading the file INCTRL.ZIP from PC MagNet, as explained in the sidebar "Utilities by Modem." You may also wish to download INCTRS.ZIP, which contains the Pascal source, resource script, and icons. These are all the files you'll need to compile INCTRL using Turbo Pascal for Windows. To decompress and separate the different components of these .ZIP files you'll need either Phil Katz's PKUNZIP or the PCUNZIP utility published in this column in our March 24, 1992, issue.

As an alternative to downloading, you can send a postcard or fax with your name and address to the attention of Katherine West, Utilities, *PC Magazine*, One Park Ave., New York, NY 10016. Please indicate the name of the utility and the disk format required: 5.25-inch (360K or 1.2MB) or 3.5-inch (720K or 1.44MB). No phone calls, please!

USING INCTRL After copying INCTRL.EXE onto your hard disk, you can load it from Program Manager, as usual. Note that the program requires protected mode (Windows Standard or Enhanced modes) to operate.

It takes hardly any more effort to install a new Windows application under INCTRL's supervision than to go through the usual File, Run dialog under Program Manager. After bringing up INCTRL, you press one button to select the install program and press a second to choose a filename for the output report. Figure 1 shows the main INCTRL window during the selection of an install program. Although the figure shows INCTRL using a Windows 3.1 common dialog box for file selection, INCTRL does not require the COMMDLG dynamic link library. If you don't have COMMDLG.DLL on your system, IN-

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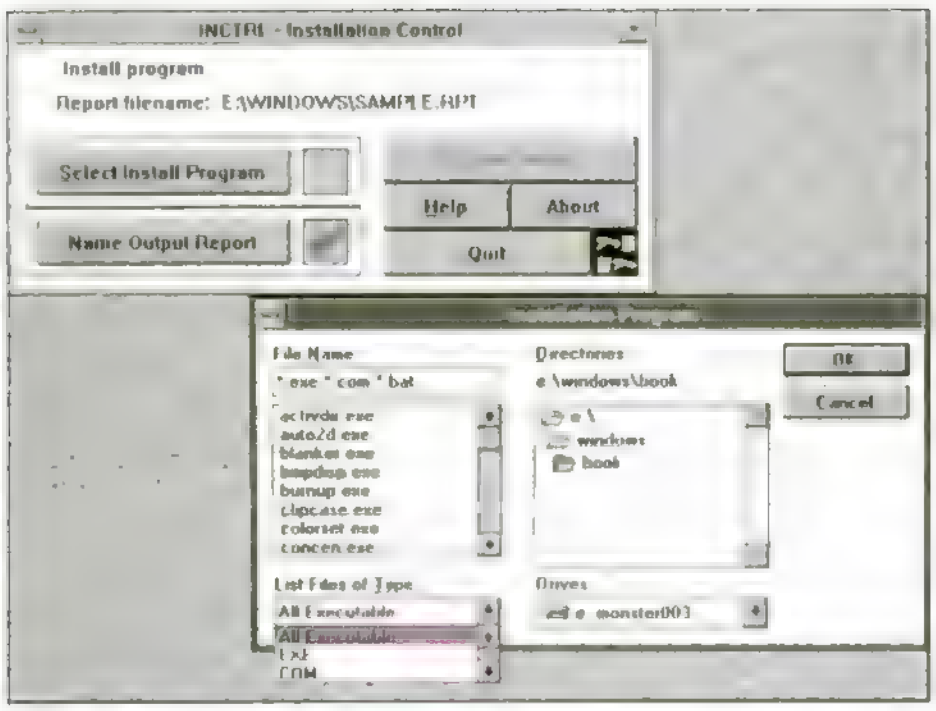

Figure 1: **INCTRL provides a simple solution to the problem of uncontrolled proliferation of program files on your disk. Here, a Windows 3.1 common dialog box is used to select an install program, though Windows 3.0 can be used as well.**

CTRL will simply use a different file selection dialog box.

When you've selected both the install program to be run and a name for INCTRL's output report, the grayed-out Perform Install button shown in Figure 1 will be enabled. Press it and INCTRL will take over the installation.

There will be an initial delay as INCTRL memorizes the file layout of the fixed disks on your system. During this interval a small window will appear to let you know what's happening. INCTRL also makes copies of WIN.INI and SYSTEM.INI at this time, using the names WININI.$$$ and SYSINI.$$$. After these preparations, INCTRL executes the application's install program; then you simply follow the application's instructions to complete the installation.

After the installation is finished, INCTRL writes a header (which includes the install filename and the current date and time) for its output report. It then scans your fixed disks again, checking each file and directory against the disk contents it memorized earlier. For items already present on its list, INCTRL compares the current size and date/time stamp with their previous values. If the stamps are different, INCTRL notes that the file has changed; if they are the same, it removes the file from the list. Any file *not* present on the list was obviously added during the installation, so INCTRL writes its name to the output report.

When this second scan of files and directories is complete, the only files left from INCTRL's original list will be those that were changed during the installation or those that were deleted. INCTRL first flips through the list and reports the name of every item that was marked as having been changed by the install program. Since every file that exists on-disk was either removed from the list or marked as changed, any remaining files *not* marked as changed must have been deleted by the install program. INCTRL reports these as well, even though it's unusual for an install program to erase files.

Next, INCTRL compares the saved copy of WIN.INI with the current WIN.INI. It compiles a list of all the section headings from the old file and checks that list against the section headings from the new file. If any were added during the installation, it writes their names to the output report and adds them to the list. INCTRL doesn't report on sections *deleted* from WIN.INI. It follows the same procedure in examining SYSTEM.INI. For each section in the .INI file, INCTRL gets a list of all the keys (for example, Load) contained in that section of the old file and reports on any keys that were added in the new file. Then it checks the *value* of each key from the old file against the value of that key in the new file. If they differ, it writes both the old value and the new to the output file.

INCTRL will notify you if it finds a duplicate section name or a duplicate key within a section of an .INI file. Normally, the Windows functions that create the keys don't allow creation of duplicate key names. A particular exception occurs in the [386Enh] section of SYSTEM.INI, however, which can have any number of lines with the key DEVICE. Windows accesses these lines during initialization, without going through the normal INI-handling functions. INCTRL also treats this key specially: It simply counts the number of times it occurs in the old files and in the new files and reports if the new file has more DEVICE lines.

An INCTRL Report

```
INSTALLATION REPORT - B:\INSTALL.EXE

Produced by INCTRL, Copyright (c) 1992 by Neil J. Rubenking
Wed 4/1/1992  09:20:29.06

*** FILES AND DIRECTORIES ADDED ***
DIR : E:\AFTERDRK
FILE: E:\WINDOWS\AFTERDAR.GRP
FILE: E:\AFTERDRK\AD_LIB.DLL
FILE: E:\AFTERDRK\ADINIT.EXE
FILE: E:\AFTERDRK\AD.EXE
. . .
FILE: E:\AFTERDRK\ADMODULE.SDK\BLANKER\MNAME.RSC
Install program added 81 files and 5 directories.

*** FILES AND DIRECTORIES CHANGED ***
FILE: E:\WINDOWS\AD.CFG
FILE: E:\WINDOWS\ADMODULE.ADS
FILE: E:\WINDOWS\AD_PREFS.INI
FILE: E:\WINDOWS\PROGMAN.INI
FILE: E:\WINDOWS\SYSTEM.ADK
FILE: E:\WINDOWS\SYSTEM.INI
FILE: E:\WINDOWS\WIN.INI
FILE: E:\WINDOWS\WININI.ADK
Install program changed 8 files and 0 directories.

*** KEYS CHANGED IN WIN.INI SECTION [windows] ***
BEFORE: load=
 AFTER: load=e:\afterdrk\ad.exe e:\afterdrk\adinit.exe
1 keys changed in WIN.INI section [windows]

*** KEYS ADDED TO SYSTEM.INI SECTION [386Enh] ***
1 DEVICE= lines added to the [386Enh] section of SYSTEM.INI
1 keys added to SYSTEM.INI section [386Enh]
```

Figure 2: **This is an abbreviated version of the report INCTRL produced after installing the After Dark screen saver.**

release 3.1 shipping

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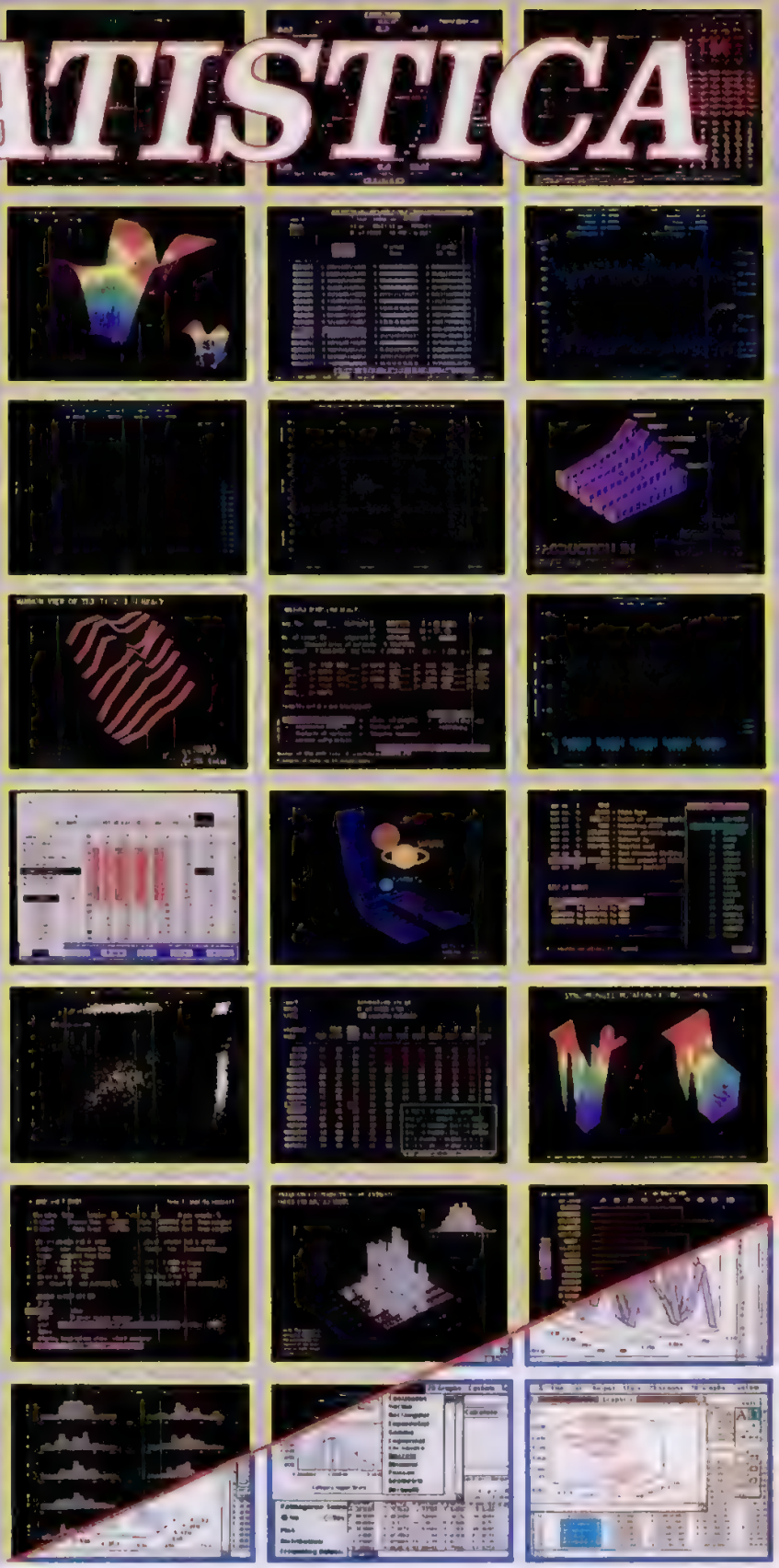

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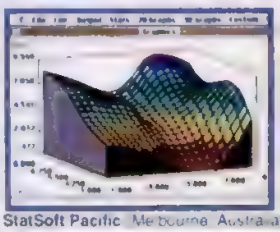

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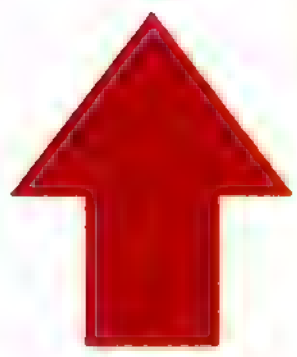

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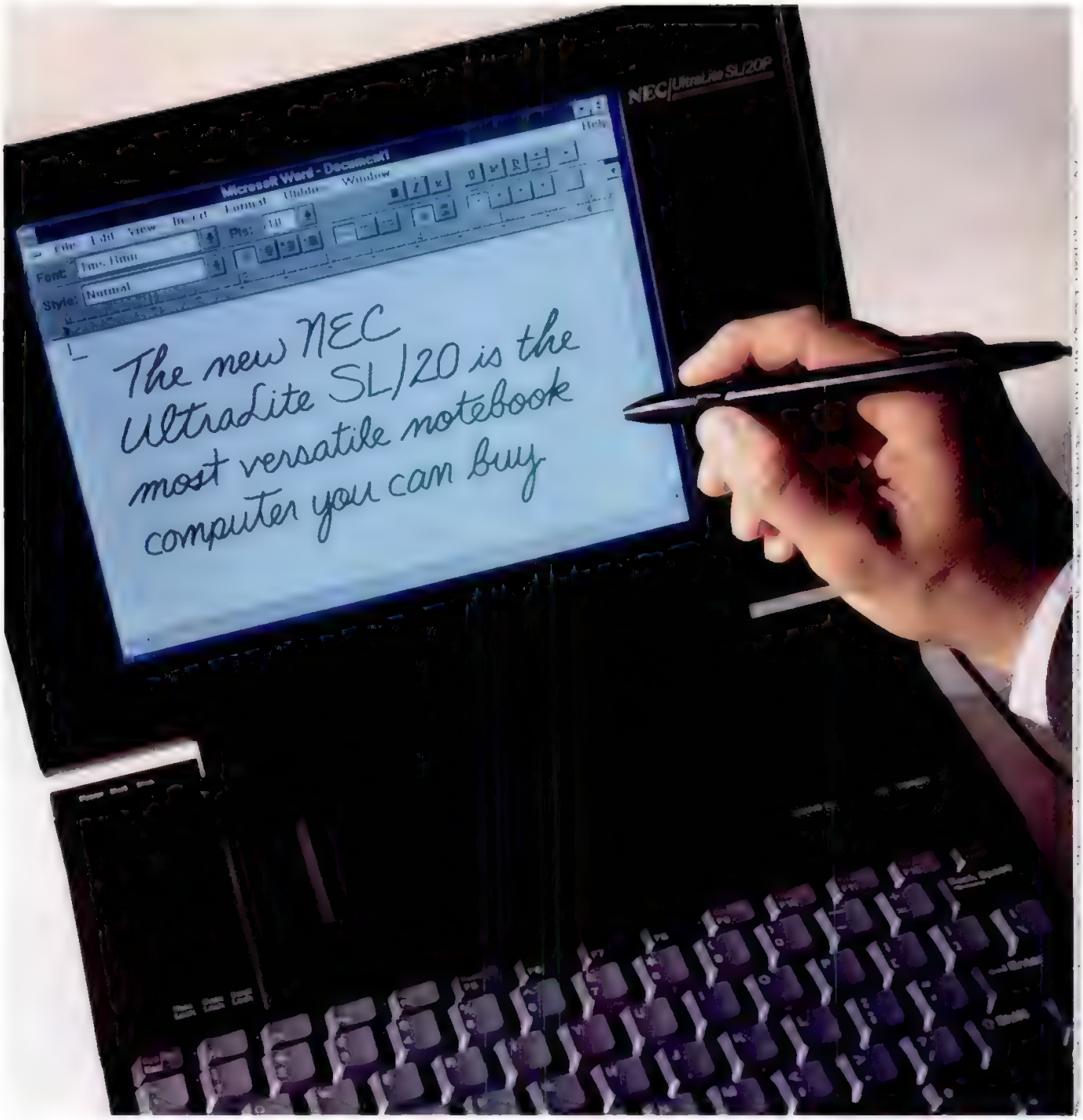

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Figure 2 shows an abbreviated version of a sample INCTRL report, which was generated while installing the After Dark screen saver. That application's install program copied 81 files and 5 directories to the disk, added a DEVICE= line to SYSTEM.INI, and added the programs AD.EXE and ADINIT.EXE to the LOAD= line in WIN.INI. There are 8 files listed as changed: 3 .INI files and 5 from an earlier incomplete attempt to uninstall the program.

Be warned that some install programs take a two-step approach that fools INCTRL: They copy a secondary install program to the hard disk and then execute that program. INCTRL thinks the installation is over when the primary program ends, so it reports that the only file added was the secondary install program. You may be able to work around this situation by using INCTRL to reexecute the secondary install program. If it reinstalls the remaining files, they'll show up as changed files in the INCTRL report.

CONFIGURING INCTRL By default, INCTRL scans all fixed disks on your system looking for file and directory changes. If you have one or more disk partitions that are never used for Windows applications, you can speed INCTRL's search and reduce its memory requirements by excluding those drives from examination. To do so, create the ASCII file INCTRL.INI in your Windows directory with a single section called [Excluded drives]. For each drive you want to exclude, add a key line such as c=1 to that section. For example, to exclude drives C: and D:, add the following:

```
[Excluded drives]
c=1
d=1
```

Your Windows directory is the default storage location for INCTRL report files. To make another directory the default, add a [Directories] section to INCTRL .INI and assign that directory to the ReptDir key, as, for example:

```
[Directories]
ReptDir=E:\INCTRL
```

UNINSTALLING WITH INCTRL Although INCTRL gives you the information you need to uninstall a program, you'll have to make some decisions based on this information. Your first step is to delete the program's icon from the Program Manager group that contains it. If the program has a group all its own, you can delete the whole group.

Now run your favorite file manager and, into your editor of choice, load the INCTRL report for the application to be removed. Look first for entire directories added during its installation; you can usually delete these entirely. You should at least consider the possibility, however, that you may have created data files in a program-created directory that you're thinking of deleting. If you're not sure, try individually deleting the files INCTRL reports in that directory and examine any that are left over.

You can, of course, delete a private .INI file if the program installed one, but most files added to the Windows and the System directories are intended to be shared with other programs. Thus, it may not be safe to delete .DLL, .DRV, .FON, or .EXE files that were installed in either of these directories. If you want to be sure, *rename* rather than delete these possibly shared files and then restart Windows. Bring up each program you installed *after* the program being removed and make sure it doesn't depend on the renamed files. If this test succeeds, you can delete the renamed files. If one of your programs refuses to run without a particular renamed file, rename it back and add that filename to the INCTRL report for the dependent program.

INCTRL's list of changed files is provided for your information; most of the time you won't want to delete any of these, since the installation program either updated them or simply recopied them on your disk. Either way, they were there before the installation and should probably stay after you uninstall the program.

If changes were made to WIN.INI or SYSTEM.INI, bring up the affected .INI file in your favorite ASCII editor. A new section is much like a new directory—you can probably erase the whole thing. If one

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or more .EXE files were added to the LOAD= or RUN= lines in the [windows] section of WIN.INI, remove them. Don't simply restore the "before" value of the line unless you're sure that other programs have not subsequently been added to these lines. On the other hand, some programs are *associated* with a particular file extension in the [extensions] section. Once the program is gone, you'll probably want to delete the WIN.INI line for that association.

Other .INI file changes must be considered on a case-by-case basis. If you're not sure whether it's safe to delete a line, turn it into a comment by putting a semicolon at the beginning of the line. Then restart Windows and run each program that was installed after the program being removed. If they all work, you can either delete the now-commented lines or leave them in place as comments. In case you find that one of your other programs *does* depend on a particular .INI file line, remove the initial semicolon and add the line to the INCTRL report file for that program.

PROGRAMMING INCTRL INCTRL was written in Turbo Pascal for Windows, using the Object Windows Library (OWL) application framework. Its resources (dialog boxes and icons) were created using Borland's Resource Workshop. The downloadable INCTRS.ZIP file contains the Pascal source code, .ICO files, and resource script for INCTRL—in short, everything you need to modify or recompile it yourself. The size of the program makes it impossible to discuss every detail here, but there are a number of specific points of interest to programmers, beginning with the question of whether or not to use common dialogs.

Windows 3.1 provides a DLL called COMMDLG that contains common dialogs for various purposes, including selection of a file to open or save. The COMMDLG DLL doesn't actually require Windows 3.1; vendors can distribute the DLL with their own products, and it will work fine under Windows 3.0. If I had used the COMMDLG unit supplied by Borland in their Windows 3.1 update for TPW, however, INCTRL would have *required* the COMMDLG DLL. INCTRL loads the necessary functions dynamically; if they're not available it uses the standard Borland dialogs unit.

INCTRL.PAS
Partial Listing

```
FUNCTION ExistFile(Name : PChar) : Boolean;
VAR
  F    : File;
  Attr : Word;
BEGIN
  Assign(F, Name);
  GetFAttr(F, Attr);
  ExistFile := DosError = 0;
END;

CONSTRUCTOR TInCtrlDialog.Init(AParent : PWindowsObject;
  AName : PChar);
VAR SysDir : FileNameBuffer;
BEGIN
  TDlgWindow.Init(AParent, AName);
    ...
  GetSystemDirectory(SysDir, BLen);
  StrCat(SysDir, '\');
  StrCat(SysDir, CommDlg);
  IF NOT ExistFile(SysDir) THEN CommDlgHandle := 0
  ELSE CommDlgHandle := LoadLibrary(CommDlg);
  IF CommDlgHandle >= 32 THEN
    BEGIN
      TFarProc(@GetOpenFileName) := GetProcAddress(CommDlgHandle,
        'GETOPENFILENAME');
      TFarProc(@GetSaveFileName) := GetProcAddress(CommDlgHandle,
        'GETSAVEFILENAME');
      IF (TFarProc(@GetOpenFileName) = NIL) OR
         (TFarProc(@GetSaveFileName) = NIL) THEN
        BEGIN
          FreeLibrary(CommDlgHandle);
          CommDlgHandle := 0;
        END;
    END
  ELSE CommDlgHandle := 0;
END;
```

Figure 3: **Although it's not required, INCTRL will make use of the Windows 3.1 common dialogs DLL, if available.**

Figure 3 shows the portion of the main window's Constructor that loads the COMMDLG functions. The Constructor first confirms the presence of the DLL by looking for it in the system directory: CommDlg is a PChar containing the string 'COMMDLG.DLL'. If the DLL is not present, the Constructor simply sets the data field CommDlgHandle to 0. If present, it attempts to load the DLL and initialize the data fields GetOpenFileName and GetSaveFileName to the addresses of the COMMDLG functions with the same names.

The methods that respond to the Select Install Program and Name Output Report buttons check the value of the CommDlgHandle field. If the value is not 0, they use the common dialog functions; if it is 0, they use the slightly less feature-rich dialogs from Borland's StdDlgs unit instead.

MEMOIRS OF AN INVISIBLE LIST BOX A simple Windows message will fill any list box with a list of files, directories, or drives that match a template. INCTRL gets its list of drives by creating an *invisible* list box and asking Windows to fill it with drives only. Figure 4 shows the SetUpWindow method used by INCTRL's main window. The array Drives contains 26 Boolean values—initially all set FALSE—that correspond to the letters A through Z. SetUpWindow allocates and initializes the TListBox object PL, giving it zero width and height and turning off its ws_Visible attribute. It sends an lb_Dir message to the list box, passing the constants $4000 (which requests drive letters) and $8000 (which excludes everything not specifically requested).

The list box is now filled with strings of the form [-a-], one for each drive on the system. SetUpWindow takes each string in turn, uppercases it, and strips away the punctuation. A call to the Windows GetDriveType API function reveals whether the drive is fixed or not. If it is, SetUpWindow checks to see if the drive is listed in the Excluded drives section of INCTRL.INI. Any fixed drive that is not excluded will have the corresponding element of the Drives array set to TRUE. Once all the items have been

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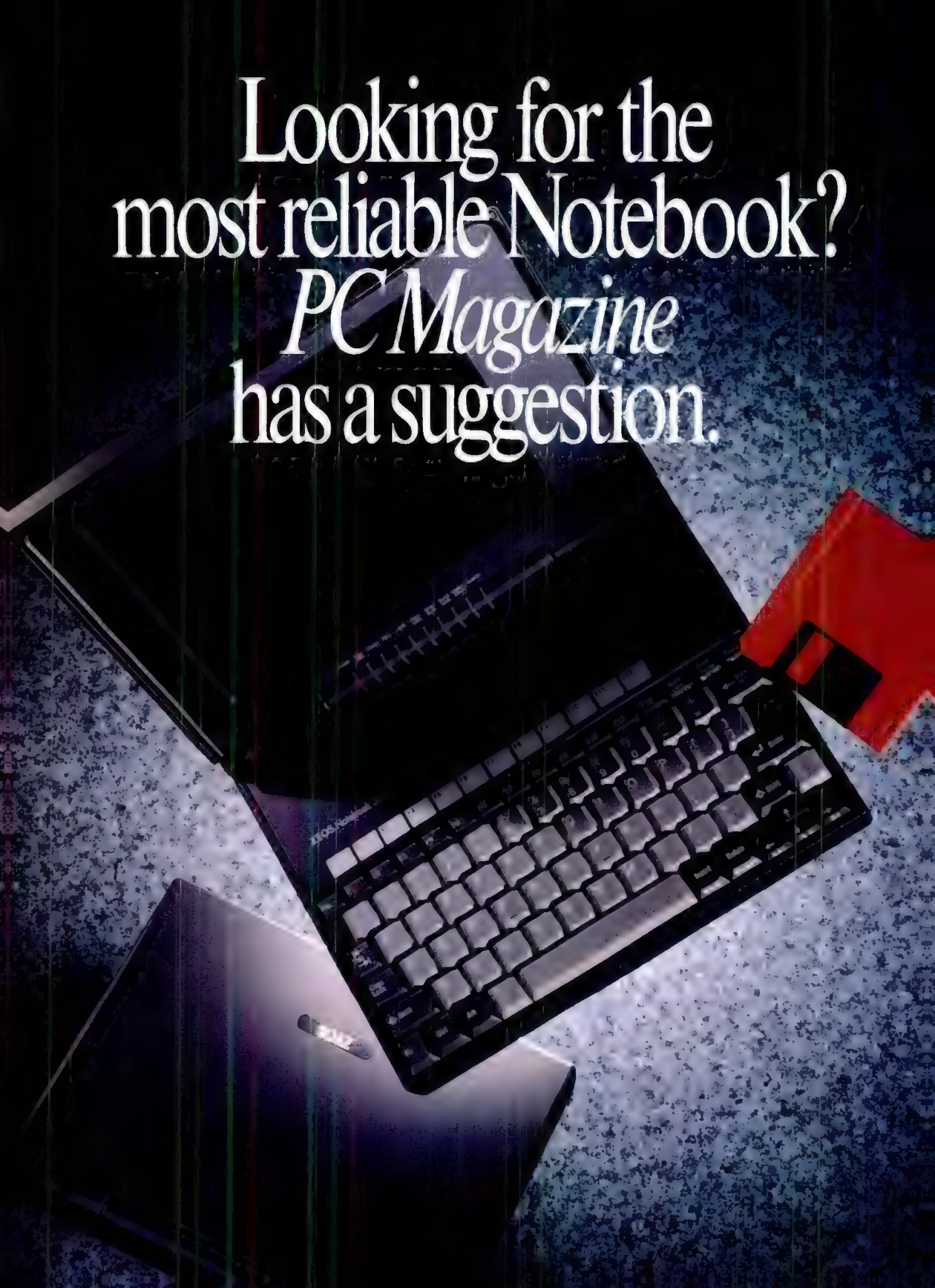

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Sys Rq
Break
Enter
Home
Pg Up

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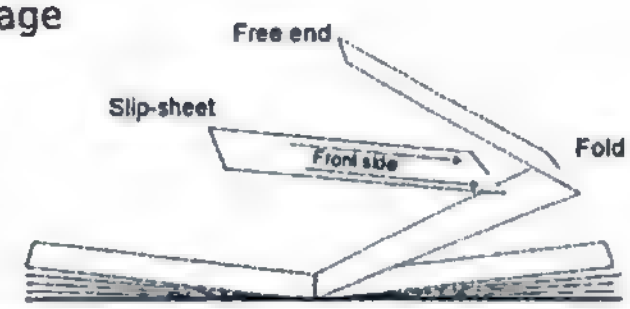

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Back

1. Follow instructions on the other side

Inverted Back

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INCTRL.PAS

Partial Listing

```
PROCEDURE TInCtrlDialog.SetUpWindow;
VAR
  PL     : PListBox;
  N, W   : Word;
  Drive  : ARRAY[0..6] OF Char;
BEGIN
  TDialog.SetUpWindow;
  New(PL, Init(@Self, 101, 0, 0, 0, 0));
    {-Invisible list box takes advantage of the Windows lb_Dir-}
    {-message to get a list of all drives on the system.      -}
  PL.Attr.Style := PL.Attr.Style AND NOT ws_Visible;
  PL := PListBox(Application.MakeWindow(PL));
  SendMessage(PL.hWindow, lb_Dir, $4000 + $8000,
    LongInt(PChar('*.*')));
  FillChar(Drives, SizeOf(Drives), FALSE);
  FOR N := 0 TO Pred(PL.GetCount) DO
    BEGIN
      PL.GetString(Drive, N);
        {-Drive now contains a string like "[-a-]" - next 2 lines-}
        {-strip the punctuation and uppercase the drive letter.  -}
      StrLCopy(drive, drive + 2, 1);
      StrUpper(drive);
      Drives[Drive[0]] :=
        GetDriveType(Ord(Drive[0])-Ord('A')) = Drive_Fixed;
      IF Drives[Drive[0]] THEN
        BEGIN
          W := GetPrivateProfileInt('Excluded drives', Drive, 0,
            'INCTRL.INI');
          IF W <> 0 THEN Drives[Drive[0]] := FALSE;
        END;
    END;
  Dispose(PL, Done);
END;
```

Figure 4: **This method uses an invisible list box to get a list of active drives from Windows.**

processed, SetUpWindow disposes of the invisible list box. Note that you can use an invisible list box such as this any time you need to get a list of files but don't want to display it.

FILESRCH—A GENERIC SEARCH ENGINE INCTRL must trace the entire directory tree of every fixed disk and store the name of each file and directory in a TStrCollection object. I could have used a recursive routine with an invisible list box, thus forcing Windows to do most of the work. But I already had a handy unit that does the job more flexibly. Figure 5 shows the FileSrch unit. It's not big, but it's powerful.

FileSrch implements two functions: Searcher and AllSearcher. You supply a file specification, a file attribute, and a search procedure, and the search routines locate every matching file and pass it to your search procedure. Searcher locates files only in the specified directory; AllSearcher also finds files in any subdirectories below the specified directory.

The search procedure can be as simple or as elaborate as you like, but its header declaration must match the SearchProc type definition at the beginning of the unit. A SearchProc is a FAR function that takes a TSearchRec VAR parameter and a PChar P, and returns a Byte. The TSearchRec is defined in the WinDOS unit; it contains the name of a file, along with its date/time stamp, size, and attributes. The PChar holds the name of the directory in which this file resides. If the SearchProc is successful it returns a 0. A nonzero return value signals an error.

INCTRL has three such functions: ListDir, Snap, and UnSnap. These are shown in Figure 6. ListDir is used to build a list of all directories on a drive. Snap is used to take a "snapshot" of the file layout before an installation. For each file, this function adds a special file-tracking record to a TSortedCollection descendant. The PFileRecord has fields to track the filename, date/time stamp, and size. Instead of keeping the whole directory, Snap stores a pointer to a list of directories and an index into that list. The FileList and DirList collections are fields of the main window object. The SearchProcs get access to these collections via a global pointer that points to the IData field.

UnSnap is invoked after the installation program runs. This function builds a PFileRecord and attempts to find it in the FileList collection. If it's already present, UnSnap checks to see if the date/time or size have changed. A changed item remains in the collection, flagged as changed, while an unchanged one gets removed from the collection. If the file or directory is not present on the list, it was obviously added by the install program, so UnSnap writes it to the output report.

The call that invokes the search is almost absurdly simple:

```
Err := AllSearcher(Mask,
  faAnyFile, Snap);
```

If a DOS error (other than error 18, "No more files") occurs during the search, AllSearcher will return the error value. The same is true if the SearchProc returns a nonzero value. Note that SearchProcs should always use error values greater than 128 in order to distinguish them from DOS errors. If all is well, the search routine returns 0.

A WINDOWS CHILD PROCESS The massive idPerform method responds to a press of the Perform Install button and supervises the selected installation program. One of its numerous tasks is to execute the new application's install program and analyze the results. But the WinExec function—used to execute programs—doesn't work like the DOS-based Exec function. When you Exec another program it becomes a child process of the main program, and the main program is suspended until the child process finishes. The WinExec function, on the other hand, produces what might be called a "cousin process": After the WinExec call, the second program proceeds simultaneously with the program that spawned it.

That's not what INCTRL needs, since INCTRL can't start analyzing the changes made by an install utility until the installation is complete. The subfunction ExecuteInstallProgram (shown in Figure 7) within the idPerform method accomplishes that task by saving the instance handle of the install program and waiting until the Windows function GetModuleUsage shows that the program is no longer in use. If the install program is a batch file, ExecuteInstallProgram builds and exe-

FILESRCH.PAS

Complete Listing

```
{$X+}
UNIT FileSrch;
(**) INTERFACE (**)
USES WinDos, Strings;
TYPE
    {-SearchProc must return 0 if Ok, > 127 if error-}
  SearchProc = FUNCTION(VAR S : TSearchRec; P : Pchar) : Byte;

  FUNCTION Searcher(Mask : PChar;
                    Attr : Byte;
                    SP   : SearchProc) : Byte;
  FUNCTION AllSearcher(Mask : PChar;
                       Attr : Byte;
                       SP   : SearchProc) : Byte;

(**) IMPLEMENTATION (**)

  FUNCTION Searcher(Mask : PChar;
                    Attr : Byte;
                    SP   : SearchProc) : Byte;
  VAR
    SR  : TSearchRec;
    Ds  : ARRAY[0..65] OF Char;
    Ns  : ARRAY[0..8] OF Char;
    Es  : ARRAY[0..3] OF Char;
    Err : Byte;
  BEGIN
    FindFirst(Mask, Attr, SR);
    IF DosError <> 0 THEN Searcher := DosError
    ELSE
      BEGIN
        Err := 0;
        FileSplit(Mask, Ds, Ns, Es);
        WHILE (DosError = 0) AND (Err = 0) DO
          BEGIN
            Err := SP(SR, Ds);
            FindNext(SR);
          END;
        IF Err <> 0 THEN Searcher := Err
        ELSE IF DosError = 18 THEN Searcher := 0
        ELSE Searcher := DosError;
      END;
  END;

VAR
  GlobalSearchDirMask : Array[0..12] OF Char;
  GlobalSearchDirAttr : Byte;
  GlobalSearchDirProc : SearchProc;

  FUNCTION SearchDir(VAR S:TSearchRec; P:PChar) : Byte; FAR;
  VAR
    NuP : ARRAY[0..79] OF Char;
    Err : Byte;
  BEGIN
    Err := 0;
    IF (S.name[0] <> '.') AND
       (S.Attr AND faDirectory > 0) THEN
      BEGIN
        StrCopy(NuP, P);
        StrCat(NuP, S.Name);
        {- handle individual files -}
        StrCat(NuP, '\');
        StrCat(NuP, GlobalSearchDirMask);
        Err := Searcher(NuP,
                        GlobalSearchDirAttr,
                        GlobalSearchDirProc);
        IF Err = 0 THEN
          BEGIN
            {- handle any subdirectories -}
            StrCopy(NuP, P);
            StrCat(NuP, S.Name);
            StrCat(NuP, '\*.*');
            Err := Searcher(NuP,
                            faDirectory OR faArchive,
                            SearchDir)
          END;
      END;
    SearchDir := Err;
  END;

  FUNCTION AllSearcher(Mask : PChar;
                       Attr : Byte;
                       SP   : SearchProc) : Byte;
  VAR
    Ds  : ARRAY[0..65] OF Char;
    Ns  : ARRAY[0..8] OF Char;
    Es  : ARRAY[0..3] OF Char;
    Err : Byte;
  BEGIN
    FileSplit(Mask, Ds, Ns, Es);
    StrCopy(GlobalSearchDirMask, Ns);
    StrCat(GlobalSearchDirmask, Es);
    GlobalSearchDirAttr := Attr;
    GlobalSearchDirProc := SP;
    {- handle individual files -}
    Err := Searcher(Mask, Attr, SP);
    StrCat(Ds, '*.*');
    IF (Err = 0) OR (Err = 18) THEN
      {- handle any subdirectories -}
      AllSearcher := Searcher(Ds,
                              faDirectory OR faArchive,
                              SearchDir)
    ELSE AllSearcher := Err;
  END;
END.
```

Figure 5: **The FileSrch unit lets a program perform the action of your choice on all files matching a template, either in the specified directory or in that directory and all directories below it.**

cutes a command line using COMMAND.COM. Otherwise, it simply WinExecs the requested program and stores the instance handle returned by WinExec in the variable InstanceID.

An InstanceID value less than 32 is a signal that WinExec failed. In such a case, ExecuteInstallProgram exits, returning FALSE. Otherwise, it waits for the install program to end by repeatedly passing InstanceID to the GetModuleUsage function until that function returns 0. Note that this technique can cause problems with the developer's Debug version of Windows; unfortunately, there's no other easy way to wait for a process to finish.

If ExecuteInstallProgram simply went into a tight loop while waiting for GetModuleUsage to return 0, Windows would come to an abrupt halt. The reason is that Windows is a nonpreemptive multitasking system. In order for all applications to get a piece of the action, every application must yield control. This is the reason for the call to the Gasp procedure, which is also shown in Figure 7. The PeekMessage loop in this procedure allows other applications to process any pending messages; it doesn't return until they have done so. Without the PeekMessage loop, the install program would never get a chance to start executing, much less finish, and the loop would never end.

You may need a procedure like Gasp for any program you write that requires a lot of processing time. If the loop's action depends on other programs continuing to function, you absolutely need such a procedure. Note that special handling is required for the wm_Quit message: You need to shut down as quickly as possible while still ensuring that any "cleanup" routines get called.

TRACKING .INI FILE CHANGES .INI files are a strange hybrid. Accessed by section and key, they function as a kind of database storage for Windows applications, but at the same time they're simply text files. A number of API functions are devoted to handling them and, as you can see by browsing through WIN.INI, Windows itself uses them abundantly. Since access time for .INI files is relatively slow, you don't want them cluttered with useless lines.

Every .INI file contains one or more section headers, identified by surrounding square brackets, and each section contains zero or more key lines. The key line consists of a key, an equals sign, and the key's value. For example:

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CIRCLE 378 ON READER SERVICE CARD

```
[windows]
Beep=Yes
Run=
```

Here, in the [windows] section, the value of the key Beep is Yes, and the key Run is empty. With Windows functions you can get or set the value of any key, or get a list of all the keys in a given section. Surprisingly, there is no function that lists all the *sections* in an .INI file. Therefore, INCTRL simply opens the .INI file and reads every line, extracting those bounded by square brackets.

Normally an .INI file can't have two identical section names or two identical key names within a section, but since the user can edit the .INI files in a text editor, anything is possible. As mentioned earlier, the one case in which duplicate keys are common occurs in the 386Enh section of SYSTEM.INI, which can contain any number of lines with the key DEVICE. Since Windows .INI file functions will only return the value of the first DEVICE line, INCTRL has to handle these lines separately. If it discovers any other duplicate key or section names, it warns you, because in most cases the duplication is an error that you should correct.

The subprocedure CompareFiles inside the idPerform method (listed in Figure 8) compares the old and new versions of an .INI file. Within CompareFiles, the function CheckSections starts by reading the old .INI file and looking for section headers. It uses a descendant of the OWL TStrCollection object to store the headers, and since the case of sections and keys is unimportant, this object overrides the Compare method to use a case-insensitive comparison. CheckSections then reads the new .INI file. Each time it finds a section that was not in the old file, it writes it to the output report and adds it to the collection. When this procedure finishes, the collection named Sects contains all the sections present in either file.

CheckKeys is executed next. It allocates KeyBuff, a 16K buffer, to hold the list of keys in each section. It then uses the ForEach iterator of the TStrCollection object to call the OneSect procedure once for each section heading in the collection. *Iterators* are a powerful feature of the OWL collection objects. ForEach executes a procedure for each item in the collection, and FirstThat and LastThat return pointers to the first and last item for which a specified Boolean function returns TRUE.

OneSect reports added and changed keys within a specified section. It calls the Windows API function GetPrivateProfileString with NIL for the key name. This causes the function to fill the buffer KeyBuff with *all* of the section's keys, separated by ASCII 0 characters. OneSect transfers this information into another TStrCollection called Keys. It compares the list of keys in the new file with this collection and reports any new ones.

OneSect checks each key from the old file before adding it to the collection. If the key is a DEVICE line in the [386Enh] section, OneSect simply increments the variable DevCount. For other keys, it checks whether the key is already present in the collection. If so, it warns you; if not, it inserts the key in the list. When processing the new file, OneSect again looks for DEVICE lines from the [386Enh] section, this time decrementing DevCount for each. DevCount will be negative only if the install program adds one or more DEVICE lines. OneSect reports the number of lines added.

Finally, OneSect uses a nested iterator to locate *changed* keys. For each key in the Keys collection it calls the proce-

INCTRL.PAS

Partial Listing

```
FUNCTION ListDir(VAR S : TSearchRec; P : PChar) : Byte; FAR;
  {-Passed to the FileSrch routines to get a list of directories.-}
VAR Fullpath : ARRAY[0..144] OF Char;
BEGIN
  ListDir := 0;
  IF S.Attr AND faDirectory = 0 THEN Exit;
  IF S.Name[0] = '.' THEN Exit;
  StrCopy(FullPath, P);
  StrCat(FullPath, S.Name);
  IF StrLen(FullPath) > 3 THEN StrCat(FullPath, '\');
  GlobalData.DirList.Insert(StrNew(fullPath));
END;

FUNCTION Snap(VAR S : TSearchRec; P : PChar) : Byte; FAR;
  {-Passed to the routines in the FileSrch unit. Assumes that-}
  {-DirList is initialized with a list of all directories.   -}
VAR Indx : Integer;
BEGIN
  Snap := 0;
    {-Ignore . and .. entries. -}
  IF S.Name[0] = '.' THEN Exit;
  Snap := 128;
  IF LowMemory THEN Exit;
  Snap := 129;
  WITH GlobalData DO
    BEGIN
      IF FileList.Count = 16380 THEN Exit;
      Snap := 0;
      DirList.Search(P, Indx);
      WITH S DO
        FileList.Insert(New(PFileRecord, Init(Name,
          Attr AND faDirectory <> 0, Indx, Time, Size, DirList)));
    END;
END;

FUNCTION UnSnap(VAR S : TSearchRec; P : PChar) : Byte; FAR;
  {-Passed to the routines in the FileSrch unit-}
VAR
  Indx     : Integer;
  PFR      : PFileRecord;
  Found    : Boolean;
BEGIN
  UnSnap := 128;
  IF LowMemory THEN Exit;
  UnSnap := 0;
  IF S.Name[0] = '.' THEN Exit;
  WITH GlobalData DO
    BEGIN
      IF NOT DirList.Search(P, Indx) THEN Found := FALSE
      ELSE
        BEGIN
          New(PFR, Init(S.Name, FALSE, Indx, 0, 0, DirList));
          Found := FileList.Search(PFR, Indx);
          Dispose(PFR, Done);
        END;
      IF Found THEN
        BEGIN
            {-If the item is on the list of existing files, -}
            {-see if it changed.  If not changed, ditch it! -}
          PFR := FileList.At(Indx);
          IF (PFR.GetTime <> S.Time) OR
             (PFR.GetSize <> S.Size) THEN
            PFR.SetChanged
          ELSE FileList.AtFree(Indx)
        END
      ELSE
        BEGIN
          IF S.Attr AND faDirectory <> 0 THEN
            BEGIN
              Inc(NumDirs);
              Write(ReptFile, 'DIR : ');
            END
          ELSE
            BEGIN
              Inc(NumFiles);
              Write(ReptFile, 'FILE: ');
            END;
          WriteLn(ReptFile, P, S.Name);
        END;
      END;
END;
```

Figure 6: **INCTRL uses the Snap and UnSnap functions to match the SearchProc type defined in the FileSrch unit.**

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INCTRL.PAS

Partial Listing

```
PROCEDURE Gasp;
VAR Mpeek : TMsg;
BEGIN
  WHILE PeekMessage(mPeek, 0, 0, 0, PM_Remove) DO
    BEGIN
      IF mPeek.Message = WM_QUIT THEN
        BEGIN
          Application.Done;
          Halt;
        END;
      TranslateMessage(mPeek);
      DispatchMessage(mPeek);
    END;
END;

FUNCTION ExecuteInstallProgram : Boolean;
VAR
  InstanceID : THandle;
  InstCmd    : PChar;
  Len        : Word;
BEGIN
  WarnWait('Executing Install program');
  ExecuteInstallProgram := FALSE;
  Len := pred(StrLen(InstProg));
    {-If it's a BAT file, execute under COMMAND.COM.-}
  IF (InstProg[Len-2] = 'B') AND
     (InstProg[Len-1] = 'A') AND
     (InstProg[Len]   = 'T') THEN
    BEGIN
      Len := Len + StrLen(GetEnvVar('COMSPEC')) + 5;
      GetMem(InstCmd, Len);
      StrCopy(InstCmd, GetEnvVar('COMSPEC'));
      StrCat(InstCmd, ' /C ');
      StrCat(InstCmd, InstProg);
      InstanceID := WinExec(InstCmd, sw_Show);
      FreeMem(InstCmd, Len);
    END
  ELSE InstanceID := WinExec(InstProg, sw_Show);
  EndWait;
  IF InstanceID < 32 THEN Exit;
  REPEAT
    Gasp;
  UNTIL GetModuleUsage(InstanceID) = 0;
  ExecuteInstallProgram := TRUE;
END;
```

Figure 7: **The ExecuteInstallProgram function executes the new application's install program and waits until it's finished.**

INCTRL.PAS

1 of 2

```
PROCEDURE CompareFiles(NuName, OlName, Nam : PChar);
{-Compare the Nu file with the Ol' file - the Ol' file-}
{-is *deleted* at the end of this procedure.          -}
VAR
  SectBuff    : ARRAY[0..80] OF Char;
  Sects       : PStrICollection;
  OldF, NewF  : Text;
  Indx        : Integer;
  NSects,
  NKeyCh,
  NKeys       : Word;

  PROCEDURE CheckSections;
  VAR
    SLen : Word;
    Indx : Integer;
  {-Read the old file and store all of its section names in a-}
  {-string collection.  Read the NEW file and report any     -}
  {-sections that didn't exist in the old file.  Hang onto   -}
  {-the section list for use in the next step.               -}
  BEGIN
    WITH IData DO
      BEGIN
        WHILE NOT EoF(OldF) DO
          BEGIN
            ReadLn(OldF, SectBuff);
            SLen := StrLen(SectBuff);
            IF (SectBuff[0] = '[') AND
               (SectBuff[pred(SLen)] = ']') THEN
              BEGIN
                StrLCopy(SectBuff, SectBuff+1, SLen-2);
                IF Sects.Search(@SectBuff, Indx) THEN
                  BEGIN
                    StrCopy(LineBuff, 'Duplicate section - ');
                    StrCat(LineBuff, SectBuff);
                    MessageBeep(mb_IconInformation);
                    MessageBox(hWindow, LineBuff, Nam,
                      mb_Ok + mb_IconInformation);
                  END
                ELSE Sects.Insert(StrNew(SectBuff));
              END;
          END;
        WHILE NOT EoF(NewF) DO
          BEGIN
            ReadLn(NewF, SectBuff);
            SLen := StrLen(SectBuff);
            IF (SectBuff[0] = '[') AND
               (SectBuff[pred(SLen)] = ']') THEN
              BEGIN
                StrLCopy(SectBuff, SectBuff+1, SLen-2);
                IF NOT Sects.Search(@SectBuff, Indx) THEN
                  BEGIN
                    Sects.Insert(StrNew(SectBuff));
                    IF NSects = 0 THEN
                      WriteLn(ReptFile, '*** ', Nam,
                        ' SECTIONS ADDED ***');
                    Inc(NSects);
                    WriteLn(ReptFile, SectBuff);
                  END;
              END;
          END;
        IF NSects > 0 THEN
          BEGIN
            wvsprintf(LineBuff, '%u sections added to ', NSects);
            WriteLn(ReptFile, LineBuff, Nam);
            WriteLn(ReptFile);
          END;
        Inc(NumSects, NSects);
      END;
  END;

  PROCEDURE CheckKeys;
  CONST KeyBuffSize = 16384;
  VAR
    KeyBuff   : PChar;
    DevCount,
    Indx      : Integer;

    PROCEDURE OneSect(Sect : PChar); FAR;
    {-Iterator routine, executed for each section in the-}
    {-Sects collection.                                 -}
    VAR
      Keys    : PStrICollection;
      V1, V2  : ARRAY[0..512] OF Char;
      P       : PChar;
      Indx    : Integer;

      PROCEDURE OneKey(Key : PChar); FAR;
      {-Iterator executed for each key in the current section-}
      BEGIN
        IF (StrIComp(key, 'device') = 0) AND
           (StrIComp(Sect, '386enh') = 0) THEN Exit;
        GetPrivateProfileString(Sect, Key, '', V1, 512, OlName);
        GetPrivateProfileString(Sect, Key, '', V2, 512, NuName);
        IF StrComp(V1, V2) = 0 THEN Exit;
        WITH IData DO
          BEGIN
            IF NKeyCh = 0 THEN
              WriteLn(ReptFile, '*** KEYS CHANGED IN ', Nam,
                ' SECTION [',Sect, '] ***');
            Inc(NKeyCh);
            Inc(NumKeyCh);
            WriteLn(ReptFile, 'BEFORE: ', key, '=', V1);
            WriteLn(ReptFile, ' AFTER: ', key, '=', V2);
          END;
      END;

  BEGIN
    NKeys := 0;
    WITH IData DO
      BEGIN
        New(Keys, Init(8, 8));
        GetPrivateProfileString(Sect, NIL, '', KeyBuff,
          KeyBuffSize, OlName);
        P := KeyBuff;
        DevCount := 0;
        WHILE P[0] <> #0 DO
          BEGIN
            IF (StrIComp(P, 'device') = 0) AND
               (StrIComp(Sect, '386enh') = 0) THEN
              BEGIN
                IF DevCount = 0 THEN Keys.Insert(StrNew(P));
```

Figure 8: **The CompareFiles function uses Windows' INI-management functions and OWL collection objects to compare two .INI files.**

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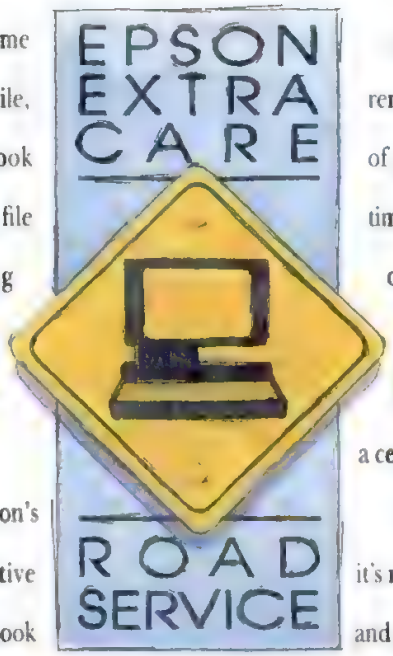

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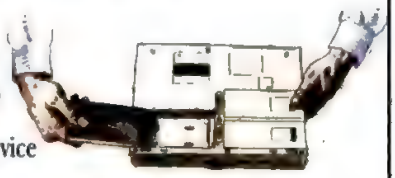

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INCTRL.PAS
2 of 2

```
        Inc(DevCount);
      END
    ELSE
      BEGIN
        IF Keys.Search(P, Indx) THEN
          BEGIN
            StrCopy(LineBuff, 'Duplicate key [');
            StrCat(LineBuff, sect);
            StrCat(LineBuff, '] ');
            StrCat(LineBuff, P);
            MessageBeep(mb_IconInformation);
            MessageBox(hWindow, LineBuff, Nam,
              mb_Ok + mb_IconInformation);
          END
        ELSE Keys.Insert(StrNew(P));
      END;
    P := StrEnd(P) + 1;
  END;
GetPrivateProfileString(Sect, NIL, NIL, KeyBuff,
  KeyBuffSize, NuName);
P := KeyBuff;
WHILE P[0] <> #0 DO
  BEGIN
    IF (StrIComp(P, 'device') = 0) AND
      (StrIComp(Sect, '386enh') = 0) THEN
      Dec(DevCount);
    IF NOT Keys.Search(P, Indx) THEN
      BEGIN
        IF NKeys = 0 THEN
          WriteLn(ReptFile, '*** KEYS ADDED TO ', Nam,
            ' SECTION [',Sect, '] ***');
        Inc(NKeys);
        Inc(NumKeys);
        GetPrivateProfileString(Sect, P, NIL, V1,
          512, NuName);
        WriteLn(ReptFile, P,'=',V1);
      END;
    P := StrEnd(P) + 1;
  END;
DevCount := -DevCount;
IF DevCount > 0 THEN
  BEGIN
    IF NKeys = 0 THEN
      WriteLn(ReptFile, '*** KEYS ADDED TO ', Nam,
        ' SECTION [',Sect, '] ***');
    Inc(NKeys, DevCount);
    Inc(NumKeys, DevCount);
    WriteLn(ReptFile, devCount, ' DEVICE= lines added',
      ' to the [386Enh] section of SYSTEM.INI');
  END;
IF NKeys > 0 THEN
  BEGIN
    wvsprintf(LineBuff, '%u keys added to ', NKeys);
    WriteLn(ReptFile, LineBuff, Nam, ' section [',
      Sect, ']');
    WriteLn(ReptFile);
  END;
NKeyCh := 0;
Keys.ForEach(@OneKey);
IF NKeyCh > 0 THEN
  BEGIN
    wvsprintf(LineBuff, '%u keys changed in ', NKeyCh);
    WriteLn(ReptFile, LineBuff, Nam, ' section [',
      Sect, ']');
    WriteLn(ReptFile);
  END;
Dispose(Keys, Done);
END;
  END;
  BEGIN
    GetMem(KeyBuff, succ(KeyBuffSize));
    Sects.ForEach(@OneSect);
    FreeMem(KeyBuff, succ(KeyBuffSize));
  END;

BEGIN
  New(Sects, Init(8, 8));
  Assign(OldF, OlName); Reset(OldF);
  Assign(NewF, NuName); Reset(NewF);
  NSects := 0;
  CheckSections;
  CheckKeys;
  Close(NewF);
  Close(OldF);
  Erase(OldF);
  Dispose(Sects, Done);
END;
```

dure OneKey. OneKey gets the value of the passed key from both the old and the new files to compare them. If they're different, it writes both to the output report.

USING WINCRT AS A FILE BROWSER - Once the report is written, INCTRL's work is done. I thought of writing a file browser module to let you look at the report, but I didn't have to, since TPW's WinCrt unit can serve as a limited sort of file browser.

WinCrt lets programmers quickly convert very simple Turbo Pascal programs to TPW. It creates a window that acts like a teletype. The Write and WriteLn functions put text on the screen, and when the window is full the text scrolls off. The virtual screen can be set to any width and height whose product is no more than 65,520. Scroll bars let you view different parts of the virtual screen.

What many TPW programmers don't realize is that WinCrt can be used in OWL-based programs as well. INCTRL displays the report in a WinCrt window that's sized so the report just fits. But there is one limitation: When you close the WinCrt window, the main application closes, too. In this case, such behavior is acceptable, because once you've seen the report, INCTRL's job is over.

I wrote INCTRL because *I* needed it. My system is an incredible mess after loading numerous Windows applications for review and then attempting to remove them. I'm sure I have WIN.INI sections that haven't been used in years. You can avoid this fate by spending an extra moment to use INCTRL each time you install a new application. □

NEIL J. RUBENKING IS TECHNICAL EDITOR OF *PC MAGAZINE*.

▪ PC Magazine Utilities Updates

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BCOPY, Version 1.2
CARDFILE.COM, Version 1.1
CHKFRAG.EXE, Version 1.5
CMDEDIT.EXE, Version 2.01
CONFIG.CTL, Version 3.0
DIRMATCH.COM, Version 3.1
EMMA.COM, Version 2.2
EMS40.SYS, Version 1.1
PCACCESS.EXE, Version 1.1
RN.COM, Version 3.0
SCHEDULE.COM, Version 1.1
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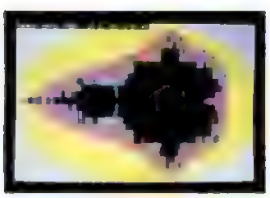

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ENVIRONMENTS

Exploring the Low-Level MIDI Input Functions

BY CHARLES PETZOLD

In the design of any API (application program interface), some compromises must be made. A low-level API gives the programmer flexibility and power, while a high-level API can make programming easier and your applications less prone to bugs.

To some degree, the designers of the API for Microsoft Windows with Multimedia Extensions avoided this trade-off by providing two sets of APIs. The low-level interface uses functions beginning with the prefixes `wave`, `midi`, `time`, and so on; higher-level control is available via the Media Control Interface (MCI).

For support of the Musical Instrument Digital Interface (MIDI), functions beginning with the prefix `midiOut` allow a program to send MIDI messages to either an internal synthesizer board or an external synthesizer connected to a MIDI Out port. The `time` functions provide a high-precision timer for sending these MIDI messages.

In this column I'll discuss functions beginning with the prefix `midiIn`, which let programs capture MIDI messages from a MIDI keyboard or other controller connected to the MIDI In port of the MIDI board.

MCI: EASY BUT LIMITED The MCI support of MIDI is based around industry-standard MIDI files, which can store anything from a short, simple phrase of music to an entire multi-instrument composition. As I'll discuss in future columns, MIDI files contain mostly MIDI messages with timing information.

If you already have MIDI files in a format suitable for Multimedia Windows, playing them using MCI is easy and straightforward. But if you want to write programs that create MIDI files, or if you want to play music without using MIDI files, you're stuck with the low-level functions.

The MCI support of MIDI is implemented by a driver named MCISEQ .DRV (MCI sequencer), which suffers a major deficiency: It can only *play* MIDI files, not record them. In other words, MCISEQ cannot read MIDI messages coming from a keyboard (or other controller) and store them in a MIDI file. The MCI commands for recording MIDI messages are documented, but the current MCISEQ driver simply does not support them. So, if you want to read MIDI messages and store them in some way, you must do it yourself using the low-level midiIn functions.

The current multimedia API lets you only play MIDI files. If you want to read MIDI messages and store them, you must use the low-level functions.

TOO WIDE A GAP Over the months I've spent working with MCI and the low-level MIDI functions, I've come to the conclusion that the gap between them is simply too wide. For example, there are two `midiOut` functions that send MIDI messages to a synthesizer. The `midiOutShortMsg` function (which I have discussed previously) is the most common. This function sends individual 1-, 2-, or 3-byte MIDI messages packed into a 32-bit-long integer. In most cases, these messages should be sent with some delay between them to play sequences of notes. To get accurate timing, you need to make use of the `time` functions, which means you need to implement your MIDI output code in a DLL (dynamic link library) and write code that is executed during hardware interrupts.

It's not that I don't like DLLs, but they add a layer of complexity to a MIDI application that really shouldn't be necessary.

The other function for outputting MIDI messages is `midiOutLongMsg`, which sends system-exclusive messages to a synthesizer. Because these system-exclusive messages can be quite long, the function uses a buffer. The buffer must be referenced in a MIDIHDR structure, and both the buffer and structure must be allocated as global memory and locked with the `midiOutPrepareHeader` function. The `midiOutLongMsg` function can be used to send a collection of short messages to a synthesizer, but all the messages are sent at once without any delay between them.

What's missing here? Well, what I'd like to see is a function that uses a buffer containing 32-bit packed MIDI messages separated by delta times in milliseconds. (That's basically what a MIDI file is, but MIDI files contain other information as well.) The function would sequentially play the MIDI messages with the specified delay times between them. Because the function would handle all the high-precision timer stuff itself, it could be called from a program rather than from a DLL. Such a function would bridge the gap between the existing low-level MIDI functions and MCI.

As we'll see, there is a similar problem

with the MIDI input functions, and it's more critical because you can't use MCI for reading MIDI input. Just as you need to use a DLL for accurate timing of MIDI output messages, you need to use a DLL to obtain accurate timings of MIDI input.

THE 13 MIDI INPUT FUNCTIONS There are 13 functions that begin with the prefix *midiIn*. Let's take a look at them.

The first two functions obtain information about the installed MIDI input devices. I demonstrated the use of these functions in the MIDIDEVS program in the March 31, 1992, Environments column. This following function obtains the number of MIDI input devices:

```
wNumDevs = midiInGetNumDevs () ;
```

To get information about each of these devices, you call:

```
wError = midiInGetDevCaps
  (wDeviceID, &mic, sizeof
  (MIDIINCAPS)) ;
```

The `wDeviceID` parameter can range from zero to one less than the number of devices. (There's no such thing as a MIDI Mapper on the input side.) The second parameter points to a structure of type MIDIINCAPS.

The next step is opening a MIDI input device. The MIDI messages coming into a MIDI In port (as well as other notification information) can be delivered either to a window procedure in your program or to a function in a DLL. You indicate which option you want when you open the device:

```
wError = midiInOpen (&hMidiIn,
  wDeviceID, dwCallback,
  dwUserData, dwFlags) ;
```

If the last parameter is CALLBACK_WINDOW, the third parameter is a window handle and the fourth parameter is ignored. If the last parameter is CALLBACK_FUNCTION, the third parameter is the address of a callback function in a DLL, and the fourth parameter is any data you want passed to that callback function. If successful, the midiInOpen call returns the MIDI input handle and generates an MM_MIM_OPEN message to the window, or an MIM_OPEN call to the callback function.

To start receiving MIDI input, you call:

```
wError = midiInStart (hMidiIn) ;
```

After this call, any short MIDI message coming into the MIDI In port will generate an MM_MIM_DATA message to the window procedure or an MIM_DATA call to the callback function. (If there's

Just as you need to use a DLL for accurate timing of MIDI output messages, you need to use a DLL to obtain accurate timings of MIDI input.

something wrong with the MIDI message, you'll get an MM_MIM_ERROR message or an MIM_ERROR call.) The DLL function is called during hardware interrupt time and has the same restrictions as the callback function used with the time functions.

If you use a callback function to get the MIDI messages, you get a 32-bit time stamp value as well as the MIDI message. This time stamp indicates the time between the midiInStart call and the time the MIDI message was received. But if you use a window procedure to get the messages, you don't get the time stamp. In that case, you can obtain the current system time from `timeGetTime` but that system time won't be entirely accurate. The MM_MIM_DATA message is posted to the window by being placed in the program's message queue, and it could be a while before the window procedure retrieved the message. Timing accuracy would be sacrified in such a case.

To stop receiving MIDI input, you call

```
wError = midiInStop (hMidiIn) ;
```

and to close the MIDI input device:

```
wError = midiInClose (hMidiIn) ;
```

This call generates an MM_MIM_CLOSE message to the window procedure or an MIM_CLOSE call to the callback function.

Four additional functions help in obtaining system-exclusive messages. This is very similar to the way you get incoming waveform audio data. You allocate a buffer from global memory and reference it in a MIDIHDR structure. Then you call

```
wError = midiInPrepareHeader
  (hMidiIn, &midihdr, sizeof
  (MIDIHDR)) ;
```

to lock the header and buffer in memory, and

```
wError = midiInAddBuffer (hMidiIn,
  &midihdr, sizeof (MIDIHDR)) ;
```

to pass it to the API. You'll get an MM_MIM_LONGDATA message or an MIM_LONGDATA call when the buffer is full. An MM_MIM_LONGERROR message or an MIM_LONGERROR call indicates an error in the system-exclusive message. The function

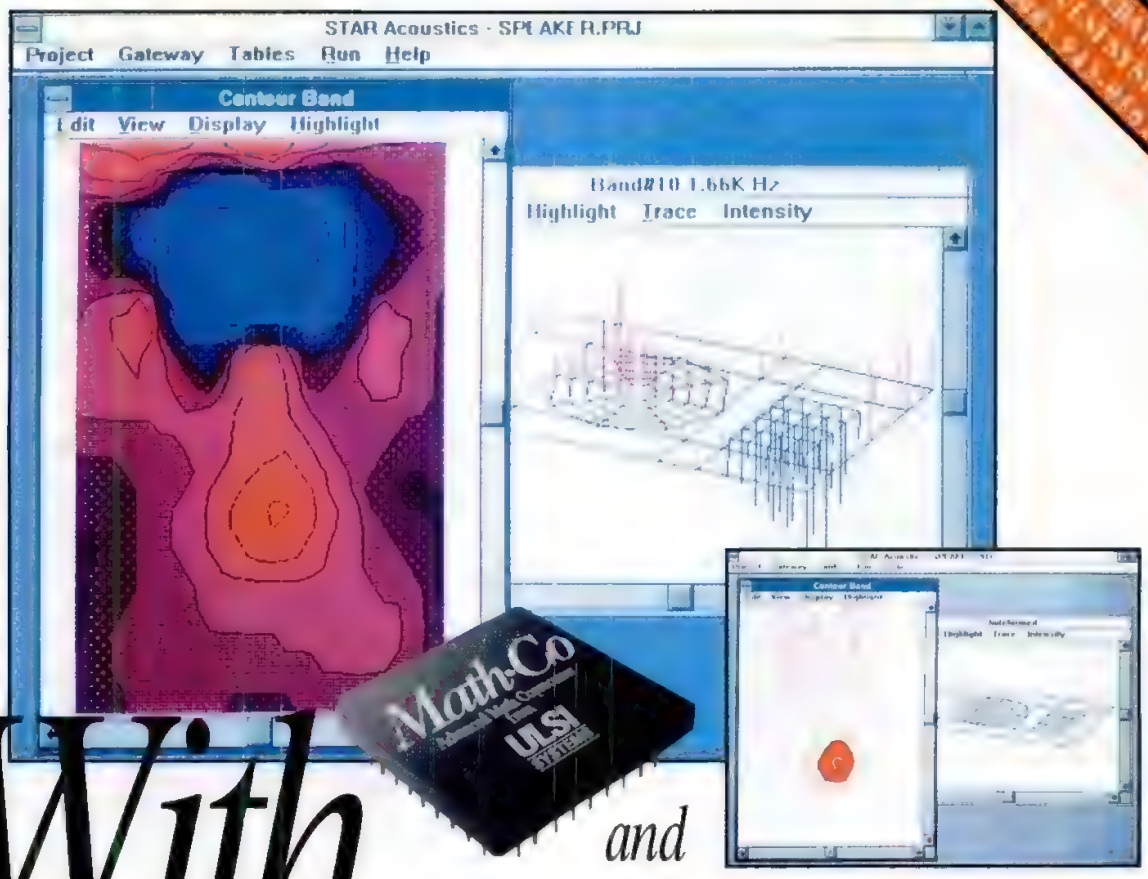
```
wError = midiInReset (hMidiIn) ;
```

marks all buffers as done and returns

MIDI Input Messages

DLL CallBack: Window Proc: Message	dwParam1 lParam	dwParam2
MIM_OPEN	—	—
MIM_DATA	MIDI Message	Timestamp
MIM_ERROR	MIDI Message	Timestamp
MIM_LONGDATA	&midihdr	Time stamp
MIM_LONGERROR	&midihdr	Time stamp
MIM_CLOSE	—	—

Figure 1: **These are the six MIDI input messages used with either a DLL callback function or a window procedure. Note that you only get the time stamps if you use a DLL callback function.**



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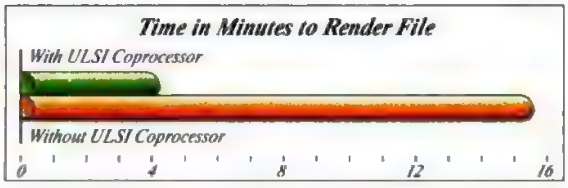

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them to the window or callback function. Before freeing the memory used by the MIDIHDR structure and the buffer, you call:

```
wError = midiInUnprepareHeader
  (hMidiIn, &midihdr,
  sizeof (MIDIHDR)) ;
```

There are two additional MIDI input functions. The function

```
wError = midiInGetID (hMidiIn,
  &wDeviceID) ;
```

returns the device ID for an open MIDI input device, and

```
wError = midiInGetErrorText
  (wError, &szText, wTextLen) ;
```

obtains a text description of a MIDI input error code.

The final function was not in the original Multimedia Windows but shows up in Windows 3.1:

```
dwReturn = midiInMessage (hMidiIn,
  wMsg, dwParam1, dwParam2) ;
```

I'm afraid I don't know very much about this function. The only documentation I have says that it's for passing driver-specific messages directly to the device driver. These apparently are not MIDI messages; I don't know what they are.

THE CALLBACK FUNCTION When you use a DLL callback function to receive notification messages from the MIDI API, it has the following format:

```
void FAR PASCAL _export CallBack
  (hMidiIn, wMsg, dwUserData,
  dwParam1, dwParam2)
```

When the system calls this function, the first parameter is set to the handle of the MIDI input device, and the third parameter is set to the `dwUserData` parameter passed to `midiInOpen`. The `wMsg` parameter is either MIM_OPEN, MIM_DATA, MIM_ERROR, MIM_LONGDATA, MIM_LONGERROR, or MIM_CLOSE. `dwParam1` and `dwParam2` are message-specific.

If you use a window to receive notification messages, you'll receive MM_MIM_OPEN, MM_MIM_DATA, MM_MIM_ERROR, MM_MIM_LONGDATA, MM_MIM_LONGERROR, and MM_MIM_CLOSE messages. These messages have the same numeric value as the six messages used for the callback function. The `wParam` parameter to the window procedure is set to the handle of the MIDI input device, and `lParam` is message-specific.

Figure 1 shows the values of `dwParam1`, `dwParam2`, and `lParam` for the six messages. As you can see, because the callback function has two 32-bit parameters and a window procedure only has one, you only get the time stamps if you use a DLL callback function. In my opinion, this is a flaw in the API. There's no real reason why a small structure couldn't have been defined to deliver both the MIDI message and the time stamp to a window procedure. But such is life. In order to get accurate timing of MIDI input messages, you need to use a DLL.

Just as there's a gap in the MIDI output API, there's a gap in the MIDI input API. It would be very nice to have buffered MIDI input. You would pass a buffer to the API and get it back filled with alternating 32-bit time stamps and MIDI messages, eliminating the necessity for using a DLL in many cases.

THE MIDI MESSAGE RATE I also think MIDI messages should be buffered because the message rate may be too high for a window procedure to handle messages individually.

MIDVUE.MSC
Complete Listing

```
#-----------------------------------------
# MIDVUE.MSC make file for Microsoft C 7.0
#-----------------------------------------

midvue.exe : midvue.obj midvue.def
     link midvue,, NUL, /nod slibcew oldnames libw mmsystem, midvue
     rc -t midvue.exe

midvue.obj : midvue.c
     cl -c -G2sw -Ow -W3 -Zp -Tp midvue.c
```

***Figure 2:* This is the Make file for Microsoft C/C++ 7.0.**

MIDVUE.BCP
Complete Listing

```
#-----------------------------------------
# MIDVUE.BCP make file for Borland C++ 3.0
#-----------------------------------------

midvue.exe : midvue.obj midvue.def
     tlink /c /n /Tw /Lc:\borlandc\lib c0ws midvue, midvue, NUL, \
          import mathws cws mmsystem, midvue
     rc -t midvue.exe

midvue.obj : midvue.c
     bcc -c -w-par -P -W -2 midvue.c
```

***Figure 3:* This is the Make file for Borland C++ 3.0.**

MIDVUE.DEF
Complete Listing

```
;-----------------------------------
; MIDVUE.DEF module definition file
;-----------------------------------

NAME            MIDVUE

DESCRIPTION     'MIDI Input Viewer (c) Charles Petzold, 1992'
EXETYPE         WINDOWS
STUB            'WINSTUB.EXE'
CODE            PRELOAD MOVEABLE DISCARDABLE
DATA            PRELOAD MOVEABLE MULTIPLE
HEAPSIZE        1024
STACKSIZE       8192
```

***Figure 4:* This is the program's module-definition file.**

MIDVUE.C

1 of 2

```
/*----------------------------------------
   MIDVUE.C -- MIDI Input Viewer
               (c) Charles Petzold, 1992
  ----------------------------------------*/

#include <windows.h>
extern "C" {
#include <mmsystem.h>
}
#include <stdlib.h>
#include <string.h>

typedef unsigned int UINT ;

#define IDM_OPEN    0x100
#define IDM_CLOSE   0x101
#define IDM_DEVICE  0x200

long FAR PASCAL _export WndProc (HWND, UINT, UINT, LONG);

char szAppName [] = "MidVue" ;
int  cxChar, cyChar ;

int PASCAL WinMain (HANDLE hInstance, HANDLE hPrevInstance,
                    LPSTR lpszCmdLine, int nCmdShow)
     {
     MSG      msg;
     HWND     hwnd ;
     WNDCLASS wndclass ;

     if (!hPrevInstance)
          {
          wndclass.style         = CS_HREDRAW | CS_VREDRAW ;
          wndclass.lpfnWndProc   = WndProc ;
          wndclass.cbClsExtra    = 0 ;
          wndclass.cbWndExtra    = 0 ;
          wndclass.hInstance     = hInstance ;
          wndclass.hIcon         = LoadIcon (NULL, IDI_APPLICATION) ;
          wndclass.hCursor       = LoadCursor (NULL, IDC_ARROW) ;
          wndclass.hbrBackground = GetStockObject (WHITE_BRUSH) ;
          wndclass.lpszMenuName  = NULL ;
          wndclass.lpszClassName = szAppName ;

          RegisterClass (&wndclass) ;
          }

     hwnd = CreateWindow (szAppName, "MIDI Input Viewer",
                          WS_OVERLAPPEDWINDOW,
                          CW_USEDEFAULT, CW_USEDEFAULT,
                          CW_USEDEFAULT, CW_USEDEFAULT,
                          NULL, NULL, hInstance, NULL) ;

     ShowWindow (hwnd, nCmdShow) ;
     UpdateWindow (hwnd);

     while (GetMessage (&msg, NULL, 0, 0))
          {
          TranslateMessage (&msg) ;
          DispatchMessage (&msg) ;
          }
     return msg.wParam ;
     }

HMENU CreateTheMenu (int iNumDevs)
     {
     HMENU      hMenu, hMenuPopup ;
     int        i ;
     MIDIINCAPS mic ;

     hMenu = CreateMenu () ;

               // Create "Status" popup menu

     hMenuPopup = CreateMenu () ;

     AppendMenu (hMenuPopup, MF_STRING                , IDM_OPEN,  "&Open") ;
     AppendMenu (hMenuPopup, MF_STRING | MF_CHECKED, IDM_CLOSE, "&Closed") ;

     AppendMenu (hMenu, MF_STRING | MF_POPUP, hMenuPopup, "&Status") ;

               // Create "Device" popup menu

     hMenuPopup = CreateMenu () ;

     for (i = 0 ; i < iNumDevs ; i++)
          {
          midiInGetDevCaps (i, &mic, sizeof (mic)) ;
          AppendMenu (hMenuPopup, MF_STRING, IDM_DEVICE + i, mic.szPname) ;
          }

     CheckMenuItem (hMenuPopup, 0, MF_BYPOSITION | MF_CHECKED) ;
     AppendMenu (hMenu, MF_STRING | MF_POPUP, hMenuPopup, "&Device") ;

     return hMenu ;
     }

void DisplayTheMessage (HDC hdc, DWORD dwMsg, int iNextRow)
     {
     static char * szStatus [] = { "Note Off", "Note On",
                                   "Polyphonic Aftertouch",
                                   "Control Change", "Program Change",
                                   "Channel Aftertouch", "Pitch Bend" } ;

     static char * szModes  [] = { "Reset All Controllers", "Local Control",
                                   "All Notes Off", "Omni Mode Off",
                                   "Omni Mode On", "Mono Mode Off",
                                   "Poly Mode On" } ;

     char  szBuffer [48] ;
     DWORD dwTime ;
     RECT  rect ;
     WORD  wStatus, wData1, wData2 ;

               // Display white rectangle to blank line

     if (dwMsg == 0)
          {
          rect.left   = 0 ;
          rect.top    = cyChar * iNextRow ;
          rect.right  = cxChar * 80 ;
          rect.bottom = cyChar * (iNextRow + 1) ;

          FillRect (hdc, &rect, GetStockObject (WHITE_BRUSH)) ;
          }
     else
          {
          MoveTo (hdc, 0, cyChar * iNextRow) ;
          SetTextAlign (hdc, TA_UPDATECP) ;

               // Display system time

          dwTime = timeGetTime () ;
          wsprintf (szBuffer, "%04X-%04X ", HIWORD (dwTime), LOWORD (dwTime)) ;
          TextOut (hdc, 0, 0, szBuffer, strlen (szBuffer)) ;

               // Break down MIDI message

          wStatus = 0x00FF & (LOBYTE (LOWORD (dwMsg)))  ;
          wData1  = 0x00FF & (HIBYTE (LOWORD (dwMsg)))  ;
          wData2  = 0x00FF & (LOBYTE (HIWORD (dwMsg)))  ;

               // Display the three bytes

          wsprintf (szBuffer, " %02X %02X %02X ", wStatus, wData1, wData2) ;
          TextOut (hdc, 0, 0, szBuffer, strlen (szBuffer)) ;

          if (wStatus < 0xF0)
               {
                    // Display channel and message type

               wsprintf (szBuffer, " Channel %d, %s, ",
                    (wStatus & 0x0F) + 1,
                    (LPSTR) szStatus [((wStatus >> 4) & 0x07) - 8]) ;

               TextOut (hdc, 0, 0, szBuffer, strlen (szBuffer)) ;

                    // Display message-specific information

               if (wStatus < 0xA0)
                    wsprintf (szBuffer, "Key %d, Velocity %d", wData1, wData2);

               else if (wStatus < 0xB0)
                    wsprintf (szBuffer, "Key %d, Pressure %d", wData1, wData2);

               else if (wStatus < 0xC0)
                    switch (wData1)
                         {
                         case 121:
                         case 123:
                         case 124:
                         case 125:
                         case 127:
                              wsprintf (szBuffer, "%s",
                                        (LPSTR) szModes [wData1 - 121]) ;
                              break ;

                         case 122:
                              wsprintf (szBuffer, "%s %s",
                                        (LPSTR) szModes [wData1 - 121],
                                        (LPSTR) (wData2 ? "On" : "Off")) ;
                              break ;

                         case 126:
                              wsprintf (szBuffer, "%s, %d Channels",
                                        (LPSTR) szModes [wData1 - 121],
                                        wData2) ;
                              break ;

                         default:
                              wsprintf (szBuffer, "Controller %d, Value %d",
                                        wData1, wData2) ;
                              break ;
                         }

               else if (wStatus < 0xD0)
                    wsprintf (szBuffer, "Voice %d", wData1 + 1) ;

               else if (wStatus < 0xE0)
                    wsprintf (szBuffer, "Pressure %d", wData1) ;

               else if (wStatus < 0xF0)
                    wsprintf (szBuffer, "Value %d", wData2 * 128 + wData1) ;
          }
```

Figure 5: **Here is the source code listing for MIDVUE.**

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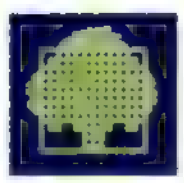

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MIDVUE.C
2 of 2

```
        else
            {
            wsprintf (szBuffer, " System Message") ;
            }

        TextOut (hdc, 0, 0, szBuffer, strlen (szBuffer)) ;
        }
    }

long FAR PASCAL _export WndProc (HWND hwnd, UINT message, UINT wParam,
                                                          LONG lParam)
    {
    static BOOL    bOpened = FALSE ;
    static DWORD * pdwMsg ;
    static HMIDIIN hMidiIn ;
    static int     iNumRows, iNextRow ;
    static WORD    wDevice ;
    DWORD          dwExtent ;
    HDC            hdc ;
    HMENU          hMenu ;
    PAINTSTRUCT    ps ;
    short          i, iNumDevs, cyClient ;

    switch (message)
        {
        case WM_CREATE:
                        // Get character size of fixed point font

            hdc = GetDC (hwnd) ;

            SelectObject (hdc, GetStockObject (SYSTEM_FIXED_FONT)) ;

            dwExtent = GetTextExtent (hdc, "M", 1) ;
            cxChar   = LOWORD (dwExtent) ;
            cyChar   = HIWORD (dwExtent) ;

            ReleaseDC (hwnd, hdc) ;

              // Get number of MIDI input devices and set up menu

            if (0 == (iNumDevs = midiInGetNumDevs ()))
                {
                MessageBeep (MB_ICONSTOP) ;
                MessageBox (hwnd, "No MIDI input devices!",
                            szAppName, MB_OK | MB_ICONEXCLAMATION) ;
                DestroyWindow (hwnd) ;
                }
            else
                {
                SetMenu (hwnd, CreateTheMenu (iNumDevs)) ;
                }

            return 0 ;

        case WM_SIZE:
            cyClient = HIWORD (lParam) ;
            iNumRows = cyClient / cyChar ;
            iNextRow = 0 ;

                // Allocate memory for storing information

            if (pdwMsg != NULL)
                free (pdwMsg) ;

            pdwMsg = (DWORD *) calloc (iNumRows, sizeof (DWORD)) ;

            return 0 ;

        case WM_COMMAND:
            hMenu = GetMenu (hwnd) ;

                    // "Open" menu command

            if (wParam == IDM_OPEN && !bOpened)
                {
                if (midiInOpen (&hMidiIn, wDevice, (DWORD) hwnd,
                                0L, CALLBACK_WINDOW))
                    {
                    MessageBeep (MB_ICONEXCLAMATION) ;
                    MessageBox (hwnd, "Cannot open MIDI In device",

                    szAppName, MB_OK | MB_ICONEXCLAMATION) ;
                    }
                else
                    {
                    CheckMenuItem (hMenu, IDM_OPEN,  MF_CHECKED) ;

                    CheckMenuItem (hMenu, IDM_CLOSE, MF_UNCHECKED) ;

                    midiInStart (hMidiIn) ;
                    bOpened = TRUE ;
                    }
                }

                    // "Close" menu command

            else if (wParam == IDM_CLOSE && bOpened)
                {
                CheckMenuItem (hMenu, IDM_OPEN,  MF_UNCHECKED) ;
                CheckMenuItem (hMenu, IDM_CLOSE, MF_CHECKED) ;

                        // Close device

                midiInStop (hMidiIn) ;
                midiInClose (hMidiIn) ;
                bOpened = FALSE ;
                }

                    // Change MIDI "Device" menu command

            else if (wParam >= IDM_DEVICE - 1)
                {
                CheckMenuItem (hMenu, IDM_DEVICE + wDevice, MF_UNCHECKED) ;
                wDevice = wParam - IDM_DEVICE ;
                CheckMenuItem (hMenu, IDM_DEVICE + wDevice, MF_CHECKED) ;

                        // Close and reopen MIDI device

                if (bOpened)
                    {
                    SendMessage (hwnd, WM_COMMAND, IDM_CLOSE, 0L) ;
                    SendMessage (hwnd, WM_COMMAND, IDM_OPEN,  0L) ;
                    }
                }

            InvalidateRect (hwnd, NULL, TRUE) ;
            return 0 ;

        case MM_MIM_DATA:

                    // Skip "Active Sensing" messages

            if (lParam == 0x00FE)
                return 0 ;

                    // Display the message

            hdc = GetDC (hwnd) ;
            SelectObject (hdc, GetStockObject (SYSTEM_FIXED_FONT)) ;

            pdwMsg [iNextRow] = lParam ;
            DisplayTheMessage (hdc, pdwMsg [iNextRow], iNextRow) ;

                    // Blank out the next row

            iNextRow = (iNextRow + 1) % iNumRows ;

            pdwMsg [iNextRow] = 0L ;
            DisplayTheMessage (hdc, pdwMsg [iNextRow], iNextRow) ;

            ReleaseDC (hwnd, hdc) ;
            return 0 ;

        case WM_PAINT:
            hdc = BeginPaint (hwnd, &ps) ;

            SelectObject (hdc, GetStockObject (SYSTEM_FIXED_FONT)) ;

            for (i = 0 ; i < iNumRows ; i++)
                if (0L != (pdwMsg [i]))
                    DisplayTheMessage (hdc, pdwMsg [i], i) ;

            EndPaint (hwnd, &ps) ;
            return 0 ;

        case WM_DESTROY :
            SendMessage (hwnd, WM_COMMAND, IDM_CLOSE, 0L) ;

            PostQuitMessage (0) ;
            return 0 ;
        }
    return DefWindowProc (hwnd, message, wParam, lParam) ;
    }
```

The MIDI protocol is a serial interface with a transfer rate of 31,250 bits per second. Each byte has a start bit and an end bit, for an effective transfer rate of 3,125 bytes per second. If most messages are the 3-byte Note On and Note Off messages, then the MIDI protocol can handle 1,041 messages per second.

That may seem like a lot—more than ever would be necessary in real life—but it's really not. Let's round it off to 1,024 messages per second. Each note requires two messages: Note On and Note Off. That means 512 notes per second. For a piece of music using all 16 channels—each one set for a different instrument voice playing one note at a time—that comes to 32 notes per instrument per second. That's fast, but it's really not inconceivable. Over 1,000 messages per second equates to less than 1 millisecond per message. That's too fast for a window procedure to be handling each message individually.

THE MIDI VIEW PROGRAM To demonstrate some of the MIDI input programs, I've written a MIDI input viewer called MIDVUE. (The name has been shortened to the six-character CompuServe maximum for storing in the PC MagNet libraries.) MIDVUE source code is shown in Figures 2 through 5. The program displays all MIDI messages coming in through a MIDI In port except for the Active Sensing message, which is a single 0xFE byte. Many MIDI controllers send the Active Sensing message several times per second to indicate that they are still connected and running. It's not a very interesting message to look at.

MIDVUE uses the `midiInGetNumDevs` and `midiInGetDevCaps` functions to create a Device menu that lists all the installed MIDI input devices. When you select Open from the Status menu in MIDVUE, the program calls `midiInOpen` and `midiInStart` to begin receiving MIDI messages. Selecting Close from the menu causes the program to call `midiInStop` and `midiInClose`.

MIDVUE processes the MM_MIM_DATA window message to display the MIDI messages. The MIDI messages are shown one per line. Each line begins with the system time obtained from the `timeGetTime` function, then the 3 bytes of the message, followed by a text description. Rather than scrolling when the listing reaches the bottom of the window, MIDVUE loops around to the top of the list, always erasing the next line in the display to indicate which was the last message received.

THE MESSAGES YOU'LL SEE You can get a good feel for MIDI messages by connecting a MIDI keyboard or other controller to the MIDI In port in your multimedia PC and running MIDVUE. I've tried out the program with a Yamaha DX7 keyboard and a Yamaha WX7 wind controller. You'll definitely see Note On messages as you play the controller. Many controllers don't use the Midi Off message when you release a key, but instead send a Midi On message with a zero velocity byte.

Some MIDI keyboards implement "aftertouch"—after you depress a key, you can press it a little harder to change the sound of the note. This generates a Channel Aftertouch message, so called because it applies to all notes on the channel. More expensive keyboards may implement Polyphonic Aftertouch, in which the aftertouch effect can be separate for each key that is depressed.

If your MIDI keyboard has a series of buttons to select among different instruments, pressing the buttons will generate Program Change messages. Most keyboards have pitch bend wheels, which generate Pitch Bend messages. Other sliders on the keyboard generate Control Change messages.

NEXT: RECORDING AND PLAYBACK Of course, once you can read MIDI messages coming from a keyboard or other controller, it's natural to start thinking about storing them and playing them back. This, alas, will require a DLL, but I've decided to first implement buffered MIDI input and output in a DLL in a form that is easy to work with from a Windows program. We'll start this project in the next issue. □

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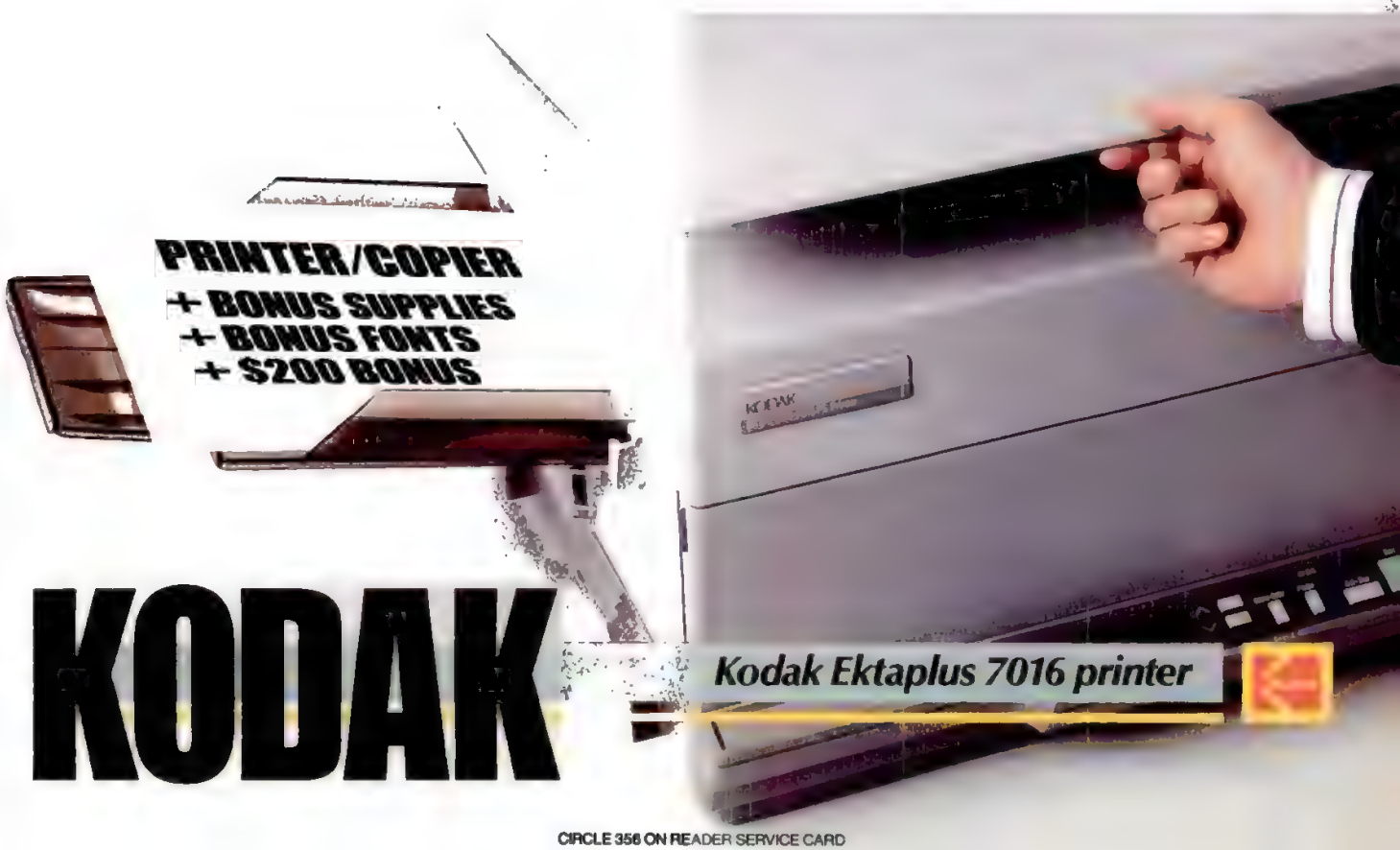

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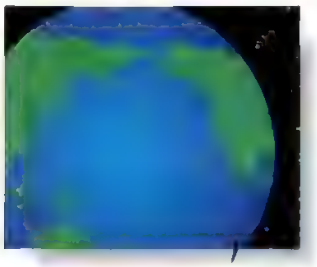

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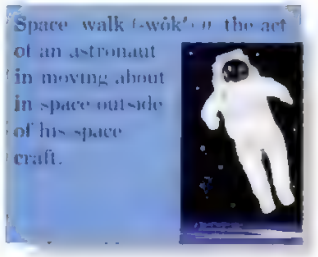

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CIRCLE 086 ON READER SERVICE CARD

POWER PROGRAMMING

The Windows Common Dialog Functions for Printing

BY RAY DUNCAN

Our tour of the Windows 3.1 common dialogs finally brings us to the subject of printing and printer setup. You may recall that during the discussion of the ChooseFont common dialog, I characterized traditional font management under Windows as programming voodoo, which I define as reliance on poorly documented procedures that are invoked ritualistically and are prone to failure for reasons that are only dimly understood. Well, the intricacies of Windows font management are only a foretaste of the surprises that lay in wait for you in the area of printing.

In theory, Windows applications are device-independent, and "painting" on the printer should be little different from painting on the screen. In reality, there are many considerations peculiar to use of the printer, including (but not limited to) the fact that the printer often supports different fonts than the screen supports; the printer may have higher or lower resolution than the screen; the printer may not contain enough memory to support all the individual pixels on a page; the printer can run out of paper or be taken off-line; the system may support several different printers at once; and two or more applications may try to send output to the printer simultaneously.

A Microsoft technical writer took note of this situation by starting the chapter on printing in the Windows 3.0 SDK *Guide to Programming* with a little gallows humor: "In Microsoft Windows, your application need not provide any printer-specific code; it can simply print to the current printer." The author then proceeded to describe, for 21 pages, exactly how to write the printer-specific code that your application didn't need to provide. Of course, we could assume that Microsoft was referring to differences between brands of printers, rather than between printers and other types of output devices—but even that doesn't make the statement true. Windows printer drivers are allowed quite a bit of latitude in the services they export, and a sophisticated graphical application cannot hope to generate high-quality hard copy unless it meticulously adapts its behavior to the capabilities of the printer driver.

The addition of a common printer dialog to Windows 3.1 relieves applications programmers of the need to design and test elaborate printing and setup dialogs.

BASICS OF WINDOWS PRINTING In Windows 3.0 and earlier, the issue of printing is complicated by the rather involved initialization an application needs to go through first. The application must call the Windows API function GetProfileString() to obtain the device= line describing the current printer from WIN.INI (or open and read WIN.INI directly), then parse the line to extract the printer brand and model, the printer type, and the printer output port. Once the printer is identified, the program must create a printer device context analogous to but not completely symmetric with a display device context, and present an elaborate dialog to the user allowing him to select the range of pages, the number of copies, the paper tray, the paper dimensions, and so forth. The application must also support a setup dialog that allows the user to reconfigure the printer or switch from one printer to another (in systems that support multiple printers).

With the device context in hand, the application can proceed to the actual business of printing. In Windows 3.0, the entire print job had to be framed with Escape() calls using the STARTDOC and ENDDOC parameters, allowing Windows to serialize printer output and keep the pages of one application from being interleaved with those of another. (The Escape() function is roughly equivalent to the DOS IOCTL function; it provides a direct channel of communication between the application and the printer driver.) GDI calls such as TextOut(), DrawText(), Rectangle(), and the like can be used with the printer DC in the expected fashion, but the application needs to keep track of page position and issue Escape() calls with the NEWFRAME parameter to eject pages when appropriate. If the output is mostly graphics, the application may have to segment the page into "bands" that won't overflow the printer's memory.

A Windows 3.0 application needs to be able to recover gracefully in case of a printer error, and must let the user abort the printing process at any time. This means that the application must contain a special callback procedure to be entered only in the event of a printer malfunction; this procedure is expected to put up an alert dialog that describes the problem to the user and lets him take action. The well-behaved Windows application should also display a free-floating dialog with a Cancel button during the entire process of printer output; fancier

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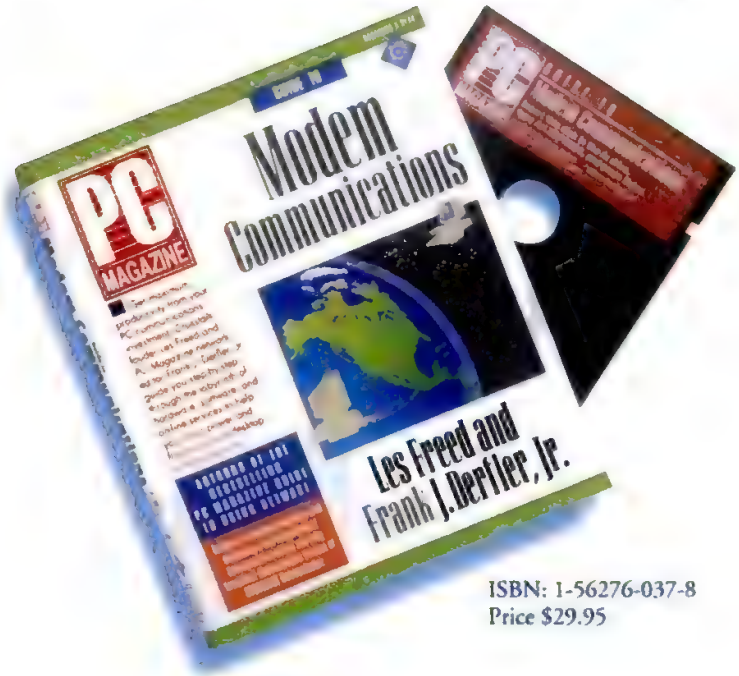

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apps audit the name of the file being printed, the current page number, and other useful information as well.

What changes does Windows 3.1 bring to this scheme? In general, the latest version of Windows drastically simplifies the application grunt work involved with printing. For typical applications, the catchall Escape() API function is superseded by the new and simpler API functions StartDoc(), StartPage(), EndPage(), EndDoc(), SetAbortProc(), AbortDoc(), and SpoolFile(). (The Escape() function is still available for backward compatibility and for applications that need to query printer capabilities.) The ChooseFont common dialog has options that let the application easily determine which fonts are supported for the printer, which for the screen, and which for both, while the addition of TrueType means that the application can leave behind most concerns about the availability (on the printer's end) of unusual font sizes or styles. Best of all, the addition of a common printer dialog relieves the applications programmer of the need to design and test elaborate printing and setup dialogs and their supporting callback functions.

You may well ask, isn't Microsoft's spiffing up of printer support in Windows 3.1 a case of bolting the barn door after the horse is long gone? It's true that few Windows programmers are inclined to revise and potentially break application source code that is already working, even if the revisions tend to simplify the code and improve maintainability. On the other hand, many programs will need to be thoroughly overhauled for OLE (object linking and embedding) and developers may use that opportunity to incorporate support for other Windows 3.1 enhancements, such as the common dialogs, TrueType, and multimedia. Furthermore, the new Windows 3.1 common dialogs and printing functions are exactly symmetric with the common dialogs and printing functions of NT/WIN32, so any conversion efforts now will be repaid in portability later.

USING PRINTDLG() The common printer dialog, whose code and resources are contained (like the other common dialogs) in the dynamic link library COMMDLG.DLL, is actually two dialogs in one. The COMMDLG.DLL entry

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point is called PrintDlg(), and you call it with a far pointer to a PRINTDLG data structure that controls various dialog options and receives the dialog's results. (The fields of the PRINTDLG structure are listed in Figure 1.) Here is the skeleton of a typical call to PrintDlg():

```
PRINTDLG pd;
.
.
.
PrintDlg(&pd);
```

PrintDlg() returns TRUE if the user successfully completes the dialog and clicks the OK button; it returns FALSE if the user clicks the CANCEL button or closes the dialog using the system menu, or if an error occurs. You can determine the cause of the error by calling CommDlgExtendedError() to get the error code.

The PRINTDLG structure contains numerous fields, but many of these can be ignored for routine applications programming. The crucial items to take note of in the PRINTDLG structure are the PD_PRINTSETUP and PD_RETURNDC bits in the Flags field. If the application calls PrintDlg() with the

The PRINTDLG Structure

Field Name	Description
StructSize	Specifies the length of the structure in bytes.
hwndOwner	Handle for the window that owns the dialog box. May be 0.
hDevMode	Handle to a memory block allocated by the common dialog function to hold a DEVMODE structure, if any.
hDevNames	Handle to a memory block allocated by the common dialog function to hold a DEVNAMES structure, if any.
hDC	Device context or information context for the printer, if requested by the PD_RETURNDC or PD_RETURNIC bit in the Flags field.
Flags	Contains various option flags that affect the initialization and behavior of the common dialog.
nFromPage	First page to print.
nToPage	Last page to print.
nMinPage	Minimum number of pages that can be specified with the From Page and To Page edit controls.
nMaxPage	Maximum number of pages that can be specified with the From Page and To Page edit controls.
nCopies	Number of copies to print.
hInstance	Identifies the data block containing a custom dialog template. Ignored if the PD_ENABLEPRINTTEMPLATE or FR_ENABLE SETUPTEMPLATE bit is not set in the Flags field.
lCustData	Specifies application-defined data to be passed to the function designated by the lpfnPrintHook or lpfnSetupHook fields.
lpfnPrintHook	Address of the application's "hook" function for the print dialog. Ignored if the PD_ENABLEPRINTHOOK bit is not set in the Flags field.
lpfnSetupHook	Address of the application's "hook" function for the printer setup dialog. Ignored if the PD_ENABLE SETUPHOOK bit is not set in the Flags field.
lpPrintTemplateName	Points to a string that specifies the name of the resource for a custom print dialog template. Ignored if the PD_ENABLE PRINTTEMPLATE bit is not set in the Flags field.
lpSetupTemplateName	Points to a string that specifies the name of the resource for a custom printer setup dialog template. Ignored if the PD_ENABLE SETUPTEMPLATE bit is not set in the Flags field.
hPrintTemplate	Handle for a memory block containing a custom print dialog template. Ignored if the PD_ENABLE PRINTTEMPLATEHANDLE bit is not set in the Flags field.
hSetupTemplate	Handle for a memory block containing a custom printer setup dialog template. Ignored if the PD_ENABLE SETUPTEMPLATEHANDLE bit is not set in the Flags field.

Figure 1: **Fields of the PRINTDLG data structure used by the PrintDlg() common dialog.**

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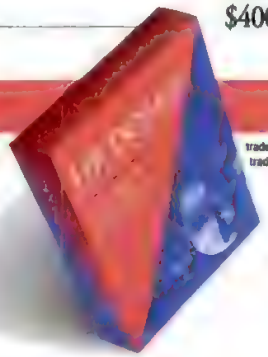

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CIRCLE 239 ON READER SERVICE CARD

PD_PRINTSETUP flag, the function displays a Printer Setup dialog that allows the user to configure the printer or switch from one printer to another, as shown in Figure 2. All of the necessary grubbing around within WIN.INI and querying of printer capabilities is buried within the common dialog library. Here is typical code for presenting the Printer Setup dialog:

```
PRINTDLG pd;
.
.
.
memset(&pd, 0, sizeof(PRINTDLG));
pd.lStructSize = sizeof(PRINTDLG);
pd.Flags = PD_PRINTSETUP;
PrintDlg(&pd);
```

If an application calls PrintDlg() with the PD_RETURNDC flag, the function will display a Print dialog that allows the user to enter the range of pages and number of copies (see Figure 3). A Setup button in the dialog lets the user detour to the Printer Setup dialog, if desired. The PrintDlg() function then determines the type of printer and allocates a printer device context. After PrintDlg() returns, the program can extract the device context, number of copies, starting and ending page numbers, and other options from the PRINTDLG data structure. The structure also contains handles for memory blocks that contain DEVMODE and DEVNAMES structures, which the application can lock down and inspect for detailed information about the printer(s). Basic code for displaying a Print dialog and then calling a routine to print a file using the returned device context might look like this:

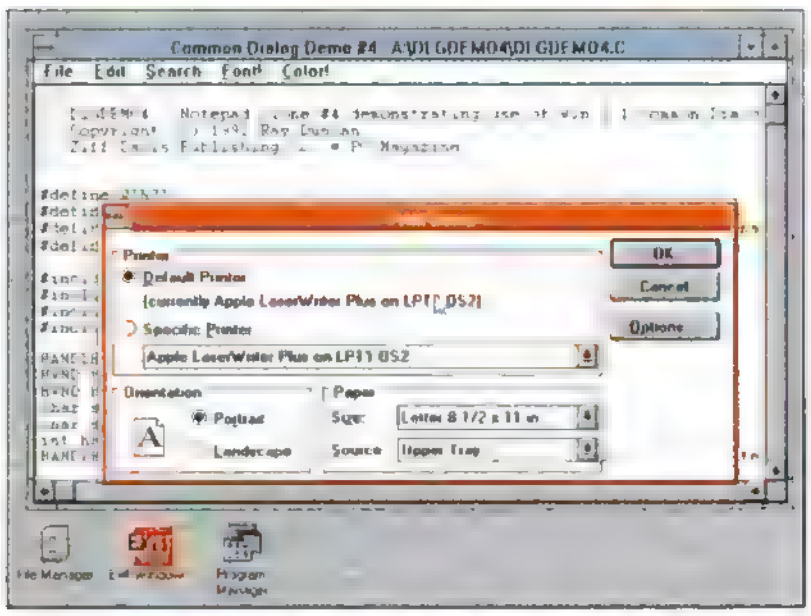


Figure 2: **This is a screen shot of DLGDEMO4, which shows the Printer Setup common dialog.**

```
PRINTDLG pd;
.
.
.
memset(&pd, 0,
 sizeof(PRINTDLG));
pd.lStructSize =
 sizeof(PRINTDLG);
pd.Flags = PD_RETURNDC;
if(PrintDlg(&pd))
{
 PrintFile(pd.hDC);
 if(pd.hDevMode)
     GlobalFree(pd.hDevMode);
 if(pd.hDevNames)
     GlobalFree(pd.hDevNames);
 DeleteDC(pd.hDC);
}
```

Like the other common dialog functions, PrintDlg() has options that allow applications to filter all of the dialog's messages with a hook function or to replace the default dialog templates with custom templates. The needs of most applications, however, will be amply served by the default Print and Printer Setup dialogs and message handling.

THE DLGDEMO4 PROGRAM This issue's demonstration program, DLGDEMO4.C, is yet another version of the DLGDEMO programs printed in the last three issues. DLGDEMO4 is a clone of the Windows Notepad program that relies on a multiline edit control for primitive editing of a plain ASCII text file. Figure 4 contains extracts of the source code that are relevant to the printing capabilities of the program. The complete source code and executable program can be downloaded from PC MagNet.

Crucial changes in DLGDEMO4 are:

- the addition of Print and Print Setup options to the File pop-up menu in the resource script DLGDEMO4.RC;
- the addition of the routines DoMenuPrintSetup(), DoMenuPrint(), and PrintFile() to the source file; and
- the addition of the Print and Print Setup menu identifiers and the addresses of the DoMenuPrintSetup() and DoMenuPrint() routines to the table menuitems[] in DLGDEMO4.C.

The program's header file was also modified to add the new menu

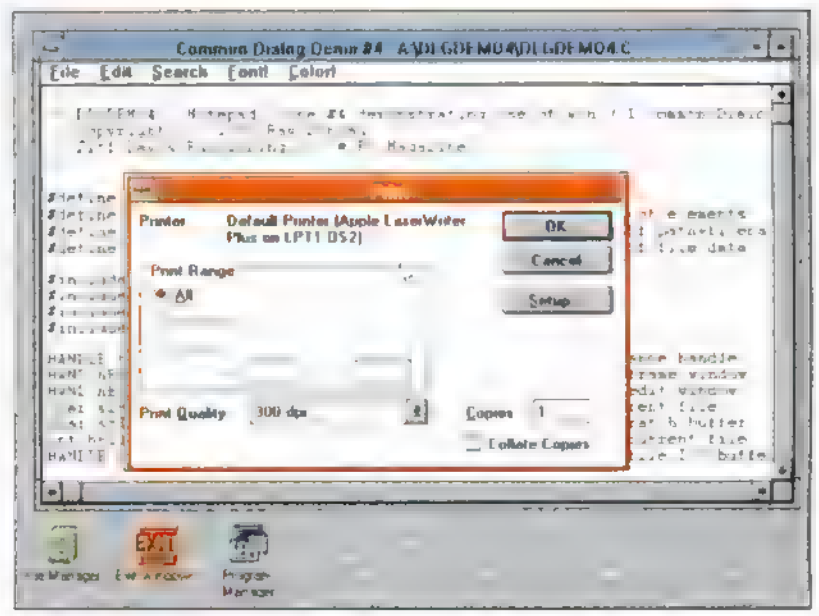


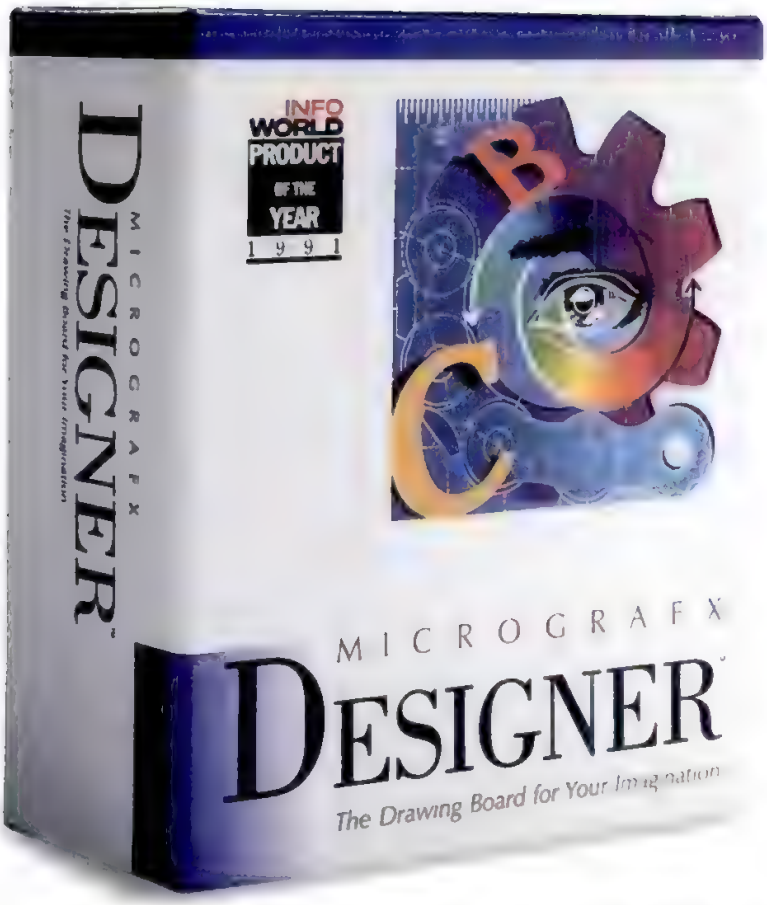
Figure 3: **This is a screen shot of DLGDEMO4, which shows the Print common dialog.**

identifiers and the prototypes for the new routines.

Let's see what happens when a user requests a print operation. Windows processes the user's menu selection and sends a WM_COMMAND message with the IDM_PRINT identifier in wParam to DLGDEMO4's main callback routine, FrameWndProc(). FrameWndProc() decodes the message using the table messages[] and dispatches the message to the routine DoCommand(). DoCommand() decodes wParam using the table menuitems[] and dispatches the message to the routine DoMenuPrint().

When DoMenuPrint() gets control, it allocates a PRINTDLG data structure, initializes it, and calls PrintDlg() to display the Print common dialog. If PrintDlg() returns TRUE, DoMenuPrint() extracts the printer device context from the PRINTDLG data structure and passes it to the routine PrintFile(). PrintFile() locks down the memory block belonging to the edit control and determines the number of lines of text, exiting immediately if there's nothing to print. Otherwise, PrintDlg() calls GetTextMetrics() to get the vertical cell size (in pixels) of the current printer font, calls GetDeviceCaps() to get the page size in pixels and the number of pixels per logical inch in both dimensions, and calculates the page margins. This information gathered, PrintFile() is ready to get to work.

PrintFile() begins the printing operation by calling StartDoc() and StartPage() to initialize the printer driver and gain control of the printer output stream. It uses messages to query the starting position and length of each line from the edit control, extracts the lines one at a



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DLGDEMO4.C

Partial Listing

```
//
// DLGDEMO4 - Notepad Clone #4 demonstrating use of Win 3.1 Common Dialogs
// Copyright (C) 1992 Ray Duncan
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//

#define WIN31

#include "string.h"
#include "windows.h"
#include "commdlg.h"
#include "dlgdemo4.h"

    .
    .
    .

struct decodeWord {                          // structure associates
    WORD Code;                               // messages or menu IDs
    LONG (*Fxn)(HWND, WORD, WORD, LONG); }; // with a function

    .
    .
    .

//
// Table of menubar item IDs and their corresponding functions.
//
struct decodeWord menuitems[] = {
    IDM_NEW, DoMenuNew,
    IDM_OPEN, DoMenuOpen,
    IDM_SAVE, DoMenuSave,
    IDM_SAVEAS, DoMenuSaveAs,
    IDM_PSETUP, DoMenuPrintSetup,
    IDM_PRINT, DoMenuPrint,
    IDM_EXIT, DoMenuExit,
    IDM_UNDO, DoMenuUndo,
    IDM_CUT, DoMenuCut,
    IDM_COPY, DoMenuCopy,
    IDM_PASTE, DoMenuPaste,
    IDM_DELETE, DoMenuDelete,
    IDM_FIND, DoMenuFind,
    IDM_REPLACE, DoMenuReplace,
    IDM_FONT, DoMenuFont,
    IDM_COLOR, DoMenuColor, } ;

    .
    .
    .

//
// DoMenuPrintSetup -- process File-PrintSetup command from menu bar.
//
LONG DoMenuPrintSetup(HWND hWnd, WORD wMsg, WORD wParam, LONG lParam)
{
    PRINTDLG pd;                             // used by common dialog

    memset(&pd, 0, sizeof(PRINTDLG));        // zero out entire structure
    pd.lStructSize = sizeof(PRINTDLG);       // length of structure
    pd.hwndOwner = hWnd;                     // owner window
    pd.Flags = PD_PRINTSETUP;                // option flags

    PrintDlg(&pd);                           // display print setup
    return(0);                               // common dialog
}

//
// DoMenuPrint -- process File-Print command from menu bar.
//
LONG DoMenuPrint(HWND hWnd, WORD wMsg, WORD wParam, LONG lParam)
{
    PRINTDLG pd;                             // used by common dialog

    memset(&pd, 0, sizeof(PRINTDLG));        // zero out entire structure
    pd.lStructSize = sizeof(PRINTDLG);       // length of structure
    pd.hwndOwner = hWnd;                     // owner window
    pd.Flags = PD_RETURNDC | PD_NOPAGENUMS   // option flags
        | PD_NOSELECTION | PD_NOSELECTION | PD_HIDEPRINTTOFILE;

    if(PrintDlg(&pd))                        // display print common dialog
    {
        PrintFile(pd.hDC);                   // print text in edit control
        if(pd.hDevMode)                      // free DEVMODE memory block
            GlobalFree(pd.hDevMode);         // allocated by common dialog
        if(pd.hDevNames)                     // free DEVNAMES memory block
            GlobalFree(pd.hDevNames);        // allocated by common dialog
        DeleteDC(pd.hDC);                    // free printer device context
    }

    return(0);
}

//
// PrintFile - print contents of edit window, using printer device
// context supplied by caller.
//
VOID PrintFile(HDC hdc)
{
    WORD cLine, iLine;                       // line length, index
    HANDLE hText;                            // local heap handle
    PSTR pText;                              // scratch pointer
    WORD maxLine, curLine;                   // line counters
    WORD curY;                               // current Y coordinate
    HFONT hFont;                             // non-prop. font handle
    int charY, pageX, pageY;                 // char & page Y dimensions
    int horzMarg, vertMarg;                  // page margins
    TEXTMETRIC tm;                           // info about font
    DOCINFO di;                              // used by StartDoc
    HCURSOR hPrevCursor;                     // save old cursor handle

    // initialize document info structure for StartDoc
    di.cbSize = sizeof(DOCINFO);
    di.lpszDocName = szFileName;
    di.lpszOutput = NULL;

    // get memory block handle, convert to pointer, get number of lines
    hText = (HANDLE) SendMessage(hEdit, EM_GETHANDLE, 0, 0L);
    pText = LocalLock(hText);
    maxLine = (WORD) SendMessage(hEdit, EM_GETLINECOUNT, 0, 0);

    if(maxLine == 0)                         // if there's nothing to
    {                                        // print, unlock memory
        LocalUnlock(hText);                  // block and bail out now
        return;
    }

    GetTextMetrics(hdc, &tm);                // get various dimensions
    charY = tm.tmHeight + tm.tmExternalLeading;
    pageY = GetDeviceCaps(hdc, VERTRES);
    horzMarg = GetDeviceCaps(hdc, LOGPIXELSX) / 2;
    curY = vertMarg = GetDeviceCaps(hdc, LOGPIXELSY) / 2;

    // get old cursor handle, change cursor to hourglass
    hPrevCursor = SetCursor(LoadCursor(hInst, IDC_WAIT));

    StartDoc(hdc, &di);                      // begin the print job
    StartPage(hdc);

    // print contents of edit control, line by line
    for(curLine = 0; curLine < maxLine; curLine++)
    {
        // get character index and length for current line
        iLine = (WORD) SendMessage(hEdit, EM_LINEINDEX, curLine, 0);
        cLine = (WORD) SendMessage(hEdit, EM_LINELENGTH, iLine, 0);

        // now draw the current line using printer device context
        TextOut(hdc, horzMarg, curY, &pText[iLine], cLine);

        curY += charY;                       // advance down page

        if(curY >= pageY - vertMarg)         // reached end of page?
        {
            curY = vertMarg;                 // yes, reset Y coordinate
            EndPage(hdc);                    // and force new page
        }
    }

    EndPage(hdc);                            // send final new-page
    EndDoc(hdc);                             // and end the print job

    SetCursor(hPrevCursor);                  // restore old cursor shape
    LocalUnlock(hText);                      // unlock edit control
    return;                                  // memory block & return
}
```

Figure 4: **These are extracts from the source code for DLGDEMO4.C; they show the routines specific to the program's printing and printer setup functionality.**

time, and prints each line with a call to TextOut(). PrintFile() maintains a "current Y coordinate" for the page, incrementing this coordinate by the character cell's vertical size as each line is printed and resetting the coordinate and requesting a new page when the lower limit of the page is reached. After all lines have been printed, PrintFile() calls EndPage() and EndDoc() to eject the last page and terminate the print stream. In order to keep the source code simple, I haven't shown the code associated with tab expansion, font selection, or error handling, or with the Cancel dialog window.

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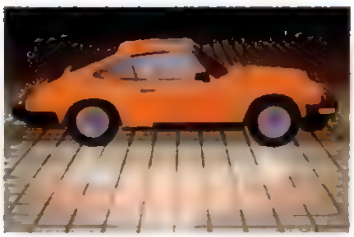
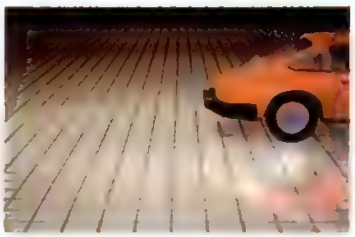

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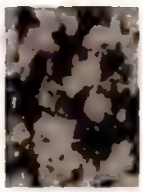

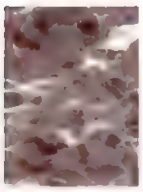

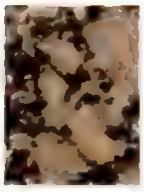
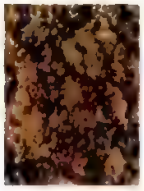

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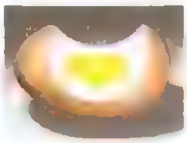
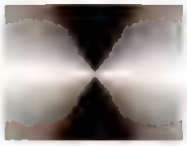
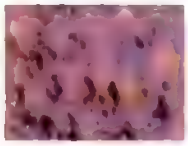
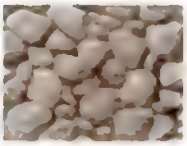
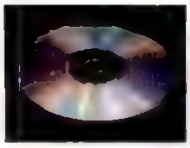


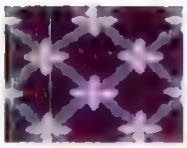
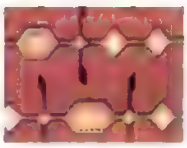
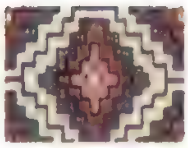
How fast is 3D Studio Release 2 software? The vase on the left was created from scratch in less than 30 minutes. And rendered in two minutes on a 486/33 PC!



All color art shown was created with Autodesk 3D Studio Release 2. Credits: Living room image courtesy of Jim Biebl, Gaviota Graphics. Atrium image courtesy of Michael Seehman, Seehman & Assoc. MTV sequence courtesy of



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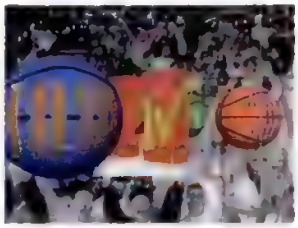

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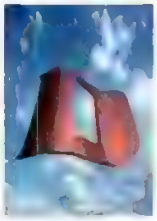

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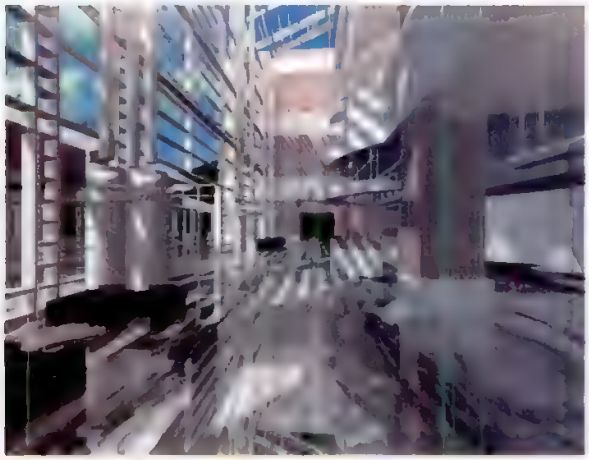

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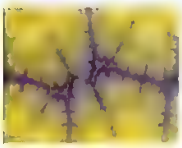
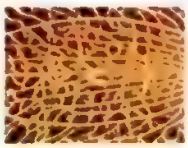

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CIRCLE 093 ON READER SERVICE CARD

DATABASES

Reclaiming Disk Space in Paradox: A script that compresses your Paradox tables Changing the Case: Macros that change the case of a word in FoxPro's editor

BY SAL RICCIARDI

Reclaiming Disk Space in Paradox

It's sometimes necessary to delete many records from a Paradox table. There might be several reasons for this: Some records may have aged beyond a cutoff point, some records were extracted to another table, or some records are simply no longer useful. You can delete table entries either interactively in EDIT mode or via a PAL script. But regardless of which method you use, you do not regain any disk space, no matter how many entries have been deleted.

Paradox never physically deletes records. Instead, it "marks" deleted records as unused records. The information contained in the entries is no longer available, but the disk space is not freed. As new records are added to the table, Paradox will first reuse the space formerly occupied by deleted entries. Failing that, it will then extend the table and increase the size of the disk file. If you never add as many records as you delete, then the "unused" disk space is forever lost.

This approach does conserve processing time and somewhat reduces disk fragmentation. However, you may well need to reclaim valuable disk space. Fortunately, there is a way to retrieve the disk space taken up by deleted records.

Paradox has the ability to restructure tables at any time. The intended use of this feature is to change, add, or delete fields in a table. But when you restructure a table, Paradox rewrites the data in that table. This removes deleted records and reclaims the associated disk space. It does this whether or not you actually make any changes to the table structure. This provides a quick and easy method to compress tables after many records have been deleted.

The PAL script shown in Figure 1 uses the method described above to squeeze deleted records out of a table and reclaim disk space. For convenience, the script operates on the current table being viewed.

Finally, note that if all records in a table are to be deleted, the Empty function (Tools, More, Empty) should be used. This operation deletes all of the records in a table by re-creating the disk file with no entries, thus freeing all of the disk space that was used to hold the records.

Dave Babcock
San Jose, California

COMPR.SC
Complete Listing

```
; COMPR.SC - PAL script to compress current table and reclaim
;   disk space lost to deleted records.

;  Make sure there is a current table
IF NIMAGES() = 0 THEN
    MESSAGE "No table to compress!"
    BEEP SLEEP 5000
    QUIT
ENDIF

;  Complete any pending operation and return to MAIN mode
IF SYSMODE() <> "Main" THEN
    DO_IT!
ENDIF

;  Save size of current table
OldSize = FILESIZE(TABLE()+".DB")

;  Restructure table with no changes to recover disk space
MENU {Modify} {Restructure} SELECT TABLE() TYPEIN TABLE() {DO-IT!}

;  Report on disk space saved by compression
NewSize = FILESIZE(TABLE()+".DB")
MESSAGE STRVAL(OldSize - NewSize) + " bytes saved!"
BEEP SLEEP 5000
```

Figure 1: **If you've deleted records in your Paradox database, you may not be using disk space economically. This PAL script can free up disk space formerly occupied by deleted records.**

▶PC MAGAZINE If you delete a lot of records in a Paradox table and want to reclaim the disk space used by those records, this is the way to do it, as page 33 of the User's Guide explains. You must use caution, however. When you issue the Modify Restructure command, Paradox creates two temporary tables in order to make a copy of your table without the deleted records. In so doing, it may require up to two or three times the disk space occupied by your table, so you should first check that enough disk space is available. You can find out how much space your table occupies by using the FILESIZE function. For example, to determine the file size (in bytes) of the table itself, you can use

```
FILESIZE(TABLE()+".DB")
```

If your table is keyed, you will need to consider the size of the index files as well, since Paradox copies those, too. A pri-

mary index file has a .PX file extension. A secondary index consists of two files, one with a .X?? extension and one with a .Y?? extension, where ?? is a number representing the position of the index field in the table's field structure. To check the remaining disk space on a drive, use the DRIVESPACE function.

Finally, keep in mind that you will only recover disk space if you have deleted enough records to fill a single disk allocation block. Paradox allocates disk space in 2K, 3K, or 4K blocks (the default is 2K) and will only release a block if it is completely empty.

A.M./P.M. Time Format

The STIME() function published in the June 25, 1991, Databases column ("Using the Standard Time Format") contained a minor glitch. It didn't account for the time between midnight and 1:00 A.M. My function, shown in Figure 2, corrects this error.

Michael Lestina
Trenton, New Jersey

STIME2.PRG

Complete Listing

```
FUNCTION stime
PARAMETER t                 && Time in military 24-hour format
vt = VAL(t)
RETURN IIF(vt > 12, STR(vt - 12, 2) + SUBSTR(t,3) + " Pm", ;
       IIF(vt = 12, t + " Pm", ;
       IIF(vt < 1, '12' + SUBSTR(t,3) + " Am", t + " Am")))
```

Figure 2: **The STIME() function converts military time into standard Am/Pm format. This version corrects an error in the one published in a previous issue.**

▶PC MAGAZINE Nice catch. In my haste to create a shorter, quicker version of Mr. Nixon's original submission, I overdid it. The function shown in Figure 2 is a slightly modified version of Mr. Lestina's corrected function. It also runs faster than our original, since it consolidates many unnecessary calls to the VAL() function into just one call.

Changing the Case

When you're programming, you may forget whether CapsLock is on or off and type in a word or two in the wrong case. Or you may have to edit a program written by a case-insensitive FoxPro programmer. If so, the macro shown in Figure 3 should help. It converts a word from lowercase to uppercase.

FOXPRO UPPERCASE MACRO

Complete Listing

```
{SHIFT+CTRL+RIGHTARROW}                ; Highlight the next word
{SHIFT+LEFTARROW}                      ; In case this is the last word of a
                                       ; line,  the excess highlight
{CTRL+X}                               ; Cut the word to the Clipboard
{CTRL+F2}                              ; Go to command window
_ClipText = UPPER(_ClipText){ENTER}    ; Run UPPER function on _ClipText
{CTRL+F1}                              ; Go back to last edit window
{CTRL+V}                               ; Paste the word
{RIGHTARROW}                           ; Go to next word
```

Figure 3: **This macro converts a word in FoxPro's editor from lowercase to uppercase.**

You can easily create a version to change a word from uppercase to lowercase by replacing the UPPER in line 6 with LOWER.

The easiest way to set up the macro is to record it by pressing Shift-F10 and then pressing the keys as shown in Figure 3. Or you can enter the macro using FoxPro's macro editor.

Sebastian Ghosh
Weehawken, New Jersey

▶PC MAGAZINE Let's hope that some future version of FoxPro makes this type of editor macro easier to accomplish in an elegant way. In the meantime, you can assign the uppercase macro to Ctrl-U and use it to convert a FoxPro keyword to uppercase, in keeping with Xbase conventions.

For the macro to work correctly, you must first position the cursor on the first character of the word you wish to change. Otherwise, only the part of the word from the cursor forward will be converted. The macro automatically moves the cursor to the next word when it's finished, so you can easily move from word to word in sequence.

The macro works by issuing the FoxPro keystrokes necessary to block mark the word and cut it to the clipboard. It then switches to the FoxPro command window and operates on the clipboard directly via FoxPro's _Cliptext system variable, which holds the clipboard's contents. Finally, the keystrokes necessary to return to the edit window and paste the word from the clipboard are issued.

If you enter the macro using the FoxPro macro editor, do not type in the comments, but only the information to the left of the semicolons in Figure 3. As Mr. Ghosh suggests, it's easy to transform this macro into one that converts words to lowercase by changing the UPPER() function to LOWER(). You can also create a version that converts a word to *proper* case—first character upper, the rest lower—by using the PROPER() function instead. I've created UPPER(), LOWER(), and PROPER() versions and assigned them to the Ctrl-U, Ctrl-L, and Ctrl-P keys, respectively. I've also saved them to a macro file called EDMAC .FKY, which you can download from PC MagNet. Look for it in the Databases section of the Utilities/Tips Forum.

Once you have the macros stored in a file, you can enter the command

```
RESTORE MACROS FROM EDMAC
```

in FoxPro's command window to make them available for use. □

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CIRCLE 329 ON READER SERVICE CARD

LANGUAGES

Word Wrapping in BASIC: How to display long strings more attractively Checking Serial Numbers: Getting and setting a disk's serial number

EDITED BY SHARON TERDEMAN

Word Wrapping in BASIC

I've found that storing the text of help messages and dialog boxes in a disk file can greatly reduce the amount of string memory needed in my programs. Since all quoted text strings are kept in DGROUP (QuickBASIC's default data segment), they reduce the amount of memory available for string and other variables. If you store them in a disk file instead, they no longer take up space in the data segment.

One problem, though, is how to display the text in an attractive fashion. For efficiency I stored each string as a single long line, but I needed a way to divide the lines—without splitting any words—before displaying them. The solution I came up with is the StringBreak function shown in Figure 1. It begins by estimating how many elements are needed, and then examines the string in portions to see where a new element can begin. Each time a blank space is encountered within the "break zone" it assigns the next element in the array. StringBreak also returns the number of active elements, so the calling program can tell how many strings need to be printed.

Kirk Woodward
Dallas, Texas

▶**PC MAGAZINE** I took a few liberties with the original code and also tightened it up by substituting integer operations and tests where strings had been used. In Mr. Woodward's version, extra code was used to break on periods, quotes, and commas. But that extra code is not really needed since words are always separated by a space.

There are two aspects of the StringBreak function that bear explanation. First, to avoid processing the input string twice, the number of elements needed is initially only estimated. Then 25 more are added for safety, to avoid an error if it turns out that more were actually needed.

Second, the code that looks for a space must also check to see if the current character is the last one in the string. If it is the last, then the current character is probably not a space, but the string must still be split there. If the string is being divided before its end, then all of the characters in the current block except the last (the space) are retained. Otherwise, all of the characters are needed. Thus

```
X - CurCol - (X = Length))
```

returns one extra character when X is equal to Length, because BASIC evaluates the "truth" of (X=Length) and substitutes either 0 or -1. This may seem tricky at first, but understand that subtracting -1 is the same as adding 1.
—Ethan Winer

STRINGBREAK FUNCTION

Complete Listing

```
DEFINT A-Z
DECLARE FUNCTION StringBreak% (Work$, Wide, Array$())

REDIM Array$(1 TO 1)                    'establish the string array

Work$ = "The quick brown fox doesn't mind getting broken down"
Work$ = Work$ + " into shorter lines at all, as you can tell."
Wide = 40
NumElements = StringBreak%(Work$, Wide, Array$())

CLS
PRINT STRING$(80, 205);                 'print a ruler
FOR X = 1 TO 8: PRINT SPC(8); STR$(X); : NEXT
FOR X = 1 TO 8: PRINT "1234567890"; : NEXT
PRINT STRING$(80, 205);

FOR X = 1 TO NumElements
  PRINT TAB(11); Array$(X)              'TAB indents the text
NEXT

FUNCTION StringBreak% (Work$, Wide, Array$()) STATIC

  Elements = LEN(Work$) \ Wide + 25      'estimate the array size
  REDIM Array$(1 TO Elements)            'establish that many elements
  Length = LEN(Work$)                    'determine this once

  CurEl = 1                              'start at element 1
  CurCol = 1                             'and at column 1

  DO

    Found = 0                            'assume we won't find a space

    FOR X = CurCol + Wide TO CurCol STEP -1          'search for a space
      IF MID$(Work$, X, 1) = " " OR X = Length THEN 'found one, or at end
        Array$(CurEl) = MID$(Work$, CurCol, X - CurCol - (X = Length))
        CurCol = X + 1                               'update the column
        Found = -1                                   'show we found it
        EXIT FOR                                     'done with this element
      END IF
    NEXT

    IF NOT Found THEN                                'no place to break it
      Array$(CurEl) = MID$(Work$, CurCol, Wide)      'so force a break
      CurCol = CurCol + Wide                         'update the column
    END IF

    CurEl = CurEl + 1                                'go to next element

  LOOP UNTIL CurCol >= Length                        'while there's more

  StringBreak% = CurEl - 1                           'assign the function

END FUNCTION
```

Figure 1: **This BASIC function accepts an incoming single string and divides it into array elements for displaying with word wrap.**

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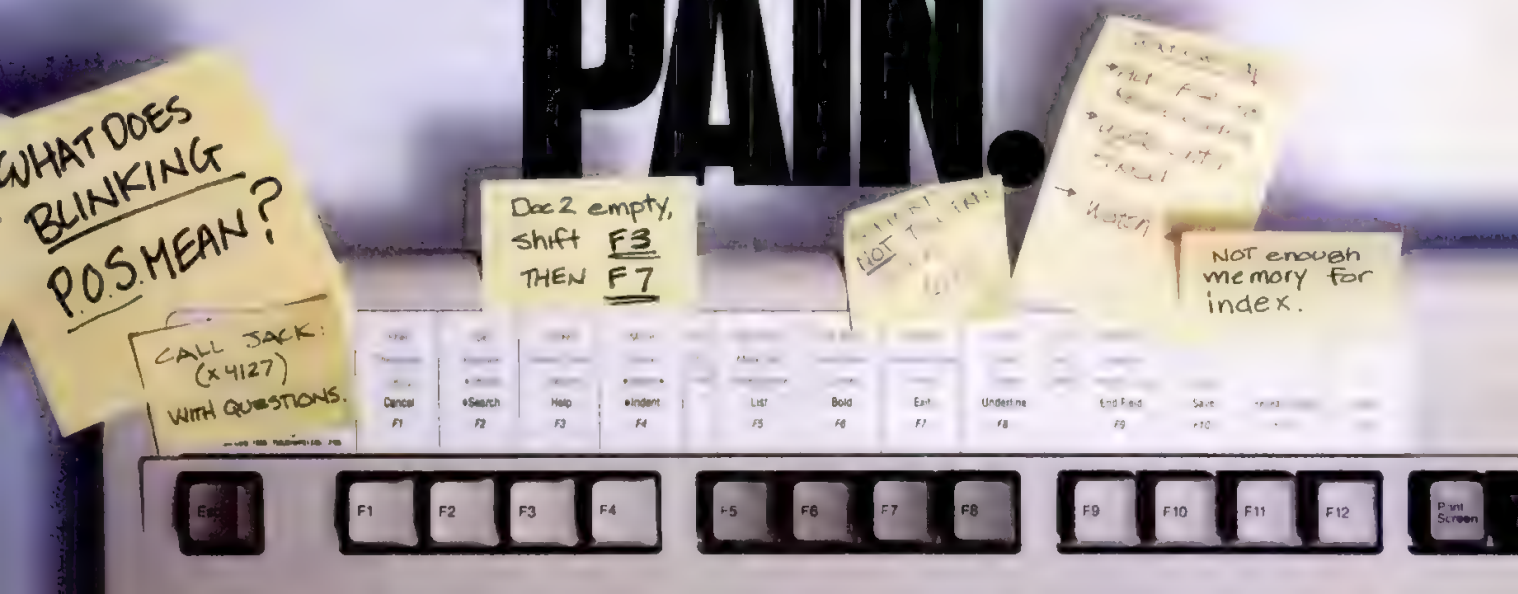

Checking Serial Numbers

Starting with DOS 4.0, the DOS FORMAT command adds a serial number to every disk it formats. This serial number resides on-disk in an extension to the BIOS Parameter Block (BPB), a portion of every disk's boot sector that includes essential information such as the number of sectors per track, number of heads, media type, and so on.

Programs can theoretically use this serial number to watch for improper disk changes, or programs can even use it as a simple kind of user validation. At the DOS command level, however, there's no way to set or check this serial number.

Fortunately, DOS function 69h will get or set the serial number. It is an undocumented function, but it's present in DOS 4.0 and 5.0. Called with 0 in the AL register, it copies the extended BPB information from the disk whose number is in BL to a buffer pointed to by DS:DX. This information includes the serial number, the volume label, and the name of the file system (FAT12 or FAT16). Called with 1 in the AL register, it writes the information from the buffer back to the disk.

Note, though, that you should *not* attempt to change the volume label using this service. You'll succeed in writing a new volume label to the extended BPB, but you won't change the actual volume label, which is a specialized kind of directory entry. And, though it appears you could change the file system name from FAT12 to FATHEAD, I wouldn't recommend doing this!

The program SERIAL.PAS in Figure 2 is a simple utility based on this handy function. Pass it a drive letter and it returns the current serial number for that drive. Pass it a drive letter and an 8-digit hexadecimal number and it *sets* that drive's serial number. Most of the program is devoted to checking for valid pa-

SERIAL.PAS

Complete Listing

```
PROGRAM Serial;
CONST
  HexDigits : ARRAY[0..15] OF Char = '0123456789ABCDEF';
TYPE
  InfoBuffer = RECORD
    InfoLevel  : Word; {should be zero}
    Serial     : LongInt;
    VolLabel   : ARRAY[0..10] OF Char;
    FileSystem : ARRAY[0..7] OF Char;
  END;
  SerString = String[9];

VAR
  IB        : InfoBuffer;
  N         : Word;
  let       : Char;
  param     : String[10];
  IsSet     : Boolean;
  NewSerial : LongInt;
  code      : Integer;

  FUNCTION SerialStr(L : LongInt) : SerString;
  VAR Temp : SerString;
  BEGIN
    Temp[0] := #9;
    Temp[1] := HexDigits[L SHR 28];
    Temp[2] := HexDigits[(L SHR 24) AND $F];
    Temp[3] := HexDigits[(L SHR 20) AND $F];
    Temp[4] := HexDigits[(L SHR 16) AND $F];
    Temp[5] := '-';
    Temp[6] := HexDigits[(L SHR 12) AND $F];
    Temp[7] := HexDigits[(L SHR 8) AND $F];
    Temp[8] := HexDigits[(L SHR 4) AND $F];
    Temp[9] := HexDigits[L AND $F];
    SerialStr := Temp;
  END;

  FUNCTION GetSerial(DiskNum : Byte;
    VAR I : InfoBuffer) : Word; Assembler;
  ASM
    MOV AH, 69h
    MOV AL, 00h
    MOV BL, DiskNum
    PUSH DS
    LDS DX, I
    INT 21h
    POP DS
    JC @Bad
    XOR AX, AX
    @Bad:
  END;

  FUNCTION SetSerial(DiskNum : Byte;
    VAR I : InfoBuffer) : Word; Assembler;
  ASM
    MOV AH, 69h
    MOV AL, 01h
    MOV BL, DiskNum
    PUSH DS
    LDS DX, I
    INT 21h
    POP DS
    JC @Bad
    XOR AX, AX
    @Bad:
  END;

  PROCEDURE ErrorOut(err : Byte);
  BEGIN
    CASE err OF
      5   : BEGIN
              WriteLn('Either the disk in ',let,': is write-',
                'protected or it lacks an extended BPB.');
              WriteLn('If the disk is not write-protected, ',
                'reformat with DOS 4 or higher.');
            END;
      15  : WriteLn('Not a valid drive letter.');
      255 : BEGIN
              WriteLn('SYNTAX: "Serial d: ########"');
              WriteLn('  where d: is the drive letter ',
                      'and ######## is the eight-digit');
              WriteLn('  hexadecimal serial number.');
              WriteLn('EXAMPLE: "Serial 1234ABCD"');
            END;
      ELSE WriteLn('DOS ERROR #',N);
    END;
    Halt(1);
  END;

BEGIN
  IF ParamCount < 1 THEN ErrorOut(255);
  IF ParamCount > 2 THEN ErrorOut(255);
  Param := ParamStr(1);
  CASE length(Param) OF
    1 : ; {ok}
    2 : IF Param[2] <> ':' THEN ErrorOut(255);
    ELSE ErrorOut(255);
  END;
  Let := UpCase(Param[1]);
  IF (Let < 'A') OR (Let > 'Z') THEN ErrorOut(15);
  IF ParamCount < 2 THEN IsSet := FALSE
  ELSE
    BEGIN
      IsSet := TRUE;
      Param := '$'+ParamStr(2);
      Val(Param, NewSerial, Code);
      IF Code <> 0 THEN ErrorOut(255);
    END;
  N := GetSerial(Ord(Let)-Ord('@'), IB);
  IF N = 0 THEN
    BEGIN
      WITH IB DO
        BEGIN
          WriteLn('Serial number is "', SerialStr(Serial),'"');
          IF IsSet THEN
            BEGIN
              Serial := NewSerial;;
              N := SetSerial(Ord(Let)-Ord('@'), IB);
              IF N = 0 THEN
                WriteLn('Successfully changed serial to "',
                        SerialStr(NewSerial),'"')
              ELSE ErrorOut(N);
            END;
        END;
    END
  ELSE ErrorOut(N);
END.
```

Figure 2: **This program uses the undocumented DOS function 69h to get or set a disk's serial number.**

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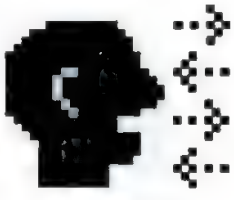

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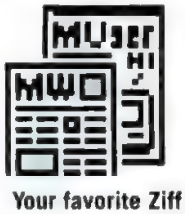

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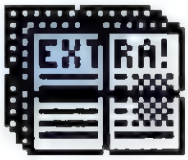

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rameters and handling errors; the real action occurs in the functions GetSerial and SetSerial.

The first parameter for SERIAL.EXE is the drive letter, optionally followed by a colon. If there is a second parameter, the program attempts to convert it into a number and assigns TRUE to the variable IsSet. Assuming the parameters are valid, the next step is a call to the GetSerial function. GetSerial takes two parameters: a drive number (A:=1, B:=2, and so on) and an InfoBuffer to hold the returned BPB information. The function itself sets AH to 69h (the function number) and AL to 00h, indicating that this is a call to *get* the serial number. It puts the disk number in BL and sets DS:DX to point to the buffer, after PUSHing the current value of DS.

Fortunately, DOS function 69h—not documented, but present in DOS 4.0 and 5.0—will get or set a disk's serial number.

All the registers are ready, so the next step is to call INT 21h. Immediately after that call, the routine POPs DS; every PUSH needs a matching POP. If the call fails, the carry flag is set, AX contains the DOS error number, and control transfers to the label @Bad. Otherwise, the function zeros out AX. An assembler function that returns a word value does so in the AX register, so this function is finished.

If the GetSerial call succeeds, the program prints out the existing serial number in the ####-#### format used by DOS. Then, if IsSet is TRUE, it proceeds to set the new serial number. It assigns the Serial field in the InfoBuffer to the new serial number and calls the SetSerial function. SetSerial differs from GetSerial in just one byte: It puts 01h in AL, signaling a call to *set* the serial number. Again, if the call succeeds, the function result is set to 0; otherwise it's set to the DOS error number.

You may want to use the SetSerial function in a program that will give a set of disks sequential serial numbers, or some other kind of systematic set of numbers. It's certainly easy enough to use. Just bear in mind that you must always call GetSerial to fill the other fields of the InfoBuffer *before* you call SetSerial to change the serial number. □

—*Neil J. Rubenking*

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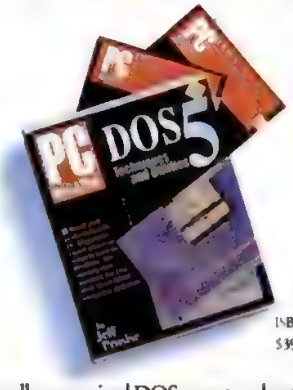

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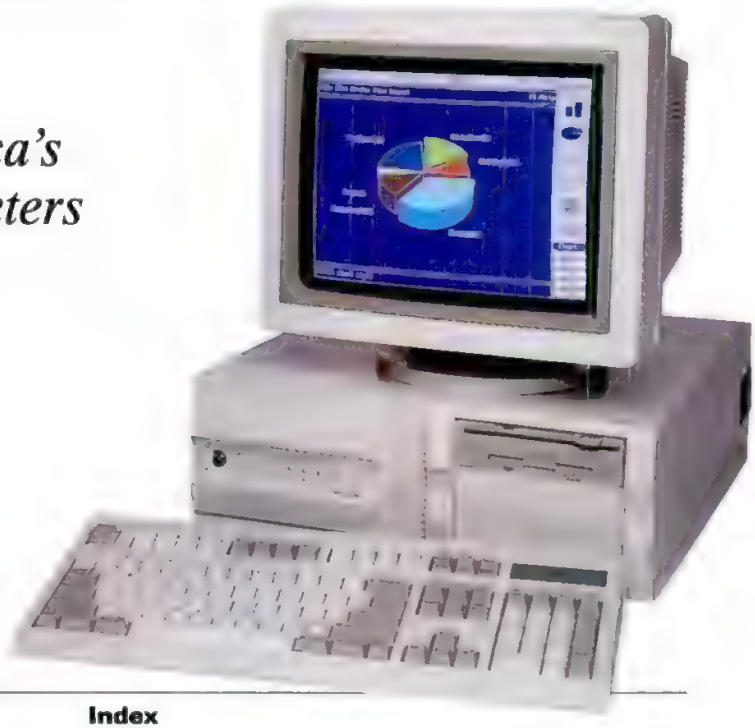

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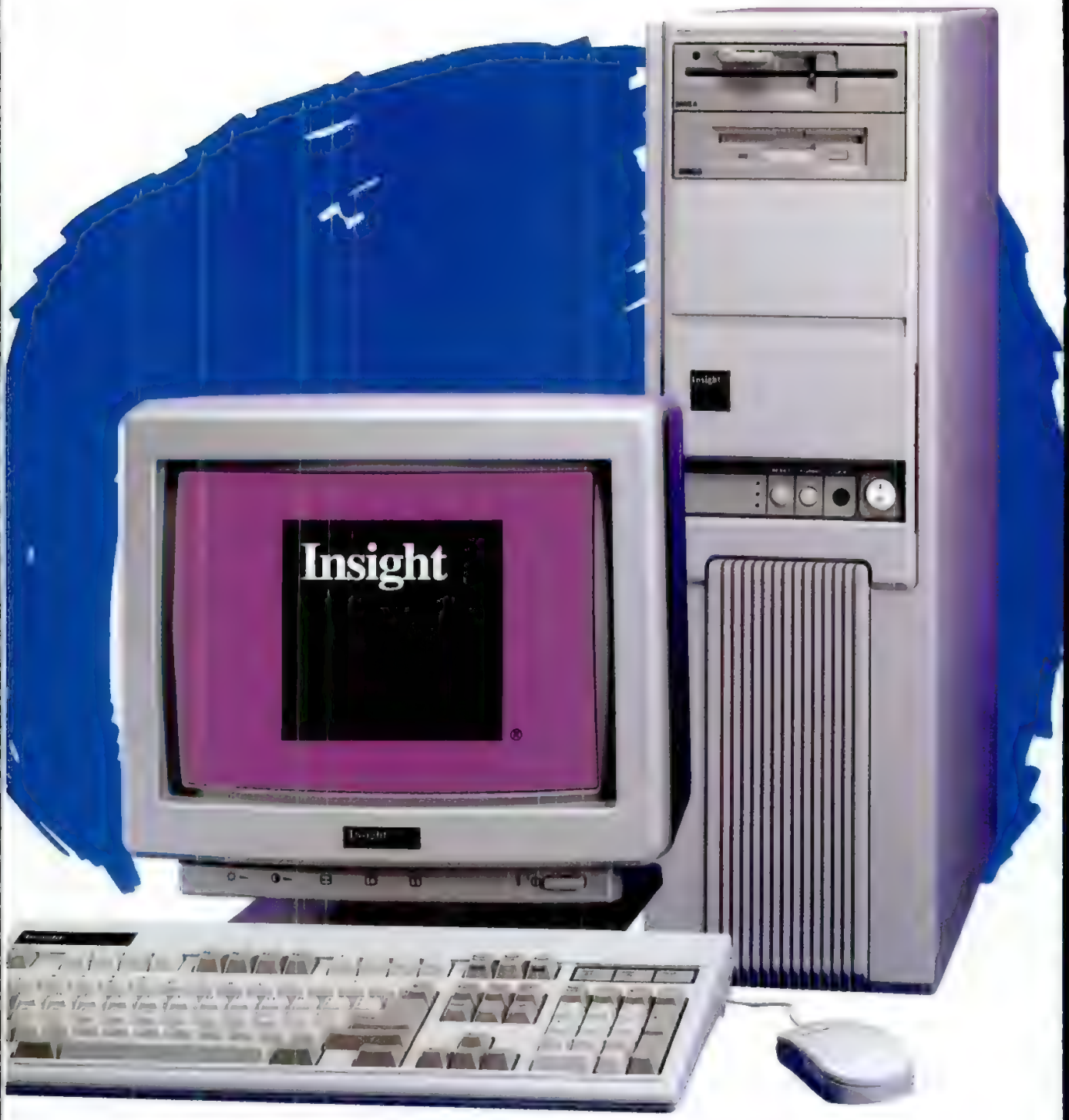

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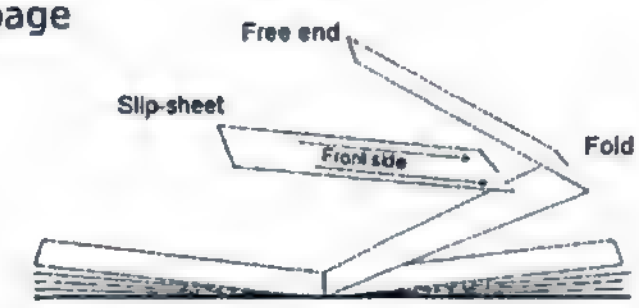

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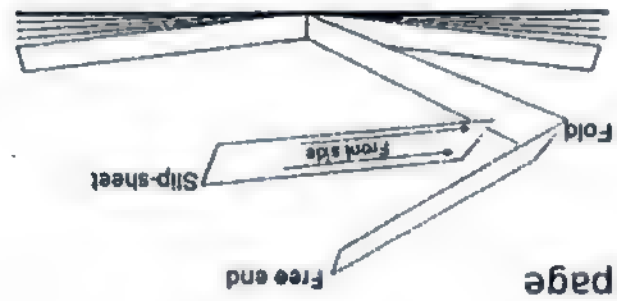

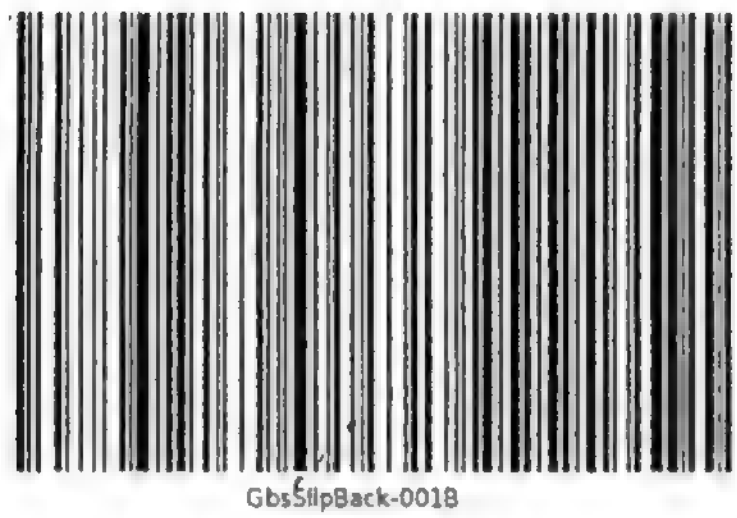

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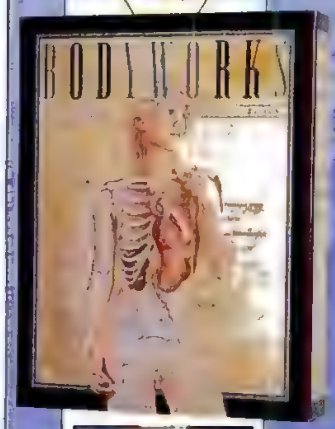

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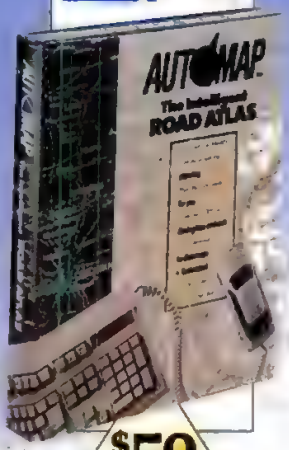

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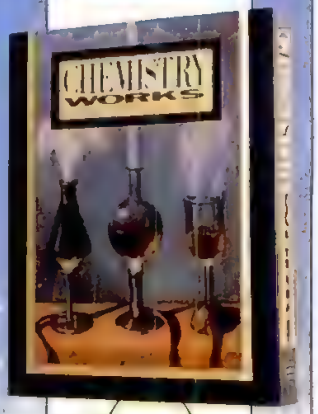

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ADVISOR

More on Compilers: PC-based compilers for PL/1, FORTRAN, and COBOL Speeding Up Slow Systems: getting better performance from older PCs

BY JOE SALEMI

More on Compilers

I run DOS and Windows 3.0 on my 80286 laptop. For training purposes (I am currently enrolled in a correspondence course in computer science), I need compilers for PL/1 or PL/C, FORTRAN, and COBOL. Can you suggest a supplier?

Frits J. Fliers
Dachau, Germany

▶PC MAGAZINE I was not at all surprised to find that many COBOL and FORTRAN compilers are available for MS-DOS systems, since both languages have been around for a long time and are still used heavily in business environments. But I was able to turn up only one PL/1 compiler for DOS. Before I talk about some of the compilers available (a full list would more than fill this column), I have to warn you that many of them are restricted to distribution in the United States only. You'll have to contact the companies directly to find out if they have European distributors or representatives from whom you can purchase the products.

The only PL/1 compiler for DOS I could find was LPI-PL/1 (Liant Software Corp., 959 Concord St., Framingham, MA 01701; 800-662-9866, 508-872-8700; $1,495). It provides the ANSI PL/1 X3.74-1981 General Purpose Subset and requires about 1.5MB of disk space and a minimum of 2MB of extended RAM. The compiler needs the PharLap DOS Extender, which Liant sells for $495, bringing the total to an expensive $1,990. Versions of LPI-PL/1 are available for various Unix systems. Liant also offers the RM/FORTRAN Develoment System ($595), an ANSI-77 FORTRAN compiler that needs 320K of RAM. It includes an integrated environment with an editor and interactive debugger.

Watcom (415 Phillip St., Waterloo, Ontario, Canada N2L 3X2; 800-265-4555, 519-886-3700) makes a couple of FORTRAN compilers, varying in price and functionality. Its least expensive offering is WATFOR-77 ($375), an integrated compiler, editor, and debugger that requires only 256K of RAM and compiles the code directly into memory. It's done in one pass, without a separate link step.

Next is Watcom FORTRAN 77 ($495), a 16-bit FORTRAN compiler that requires 640K of RAM and includes a protected-mode compiler and linker, interactive debugger, overlay manager, and graphics support. At the high end is Watcom FORTRAN 77/386 ($795), a full 32-bit FORTRAN compiler that requires a 386 or 486 machine with a minimum of 640K of RAM.

The Microsoft FORTRAN Optimizing Compiler (Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080; $450) includes Microsoft's standard CodeView debugger and Programmer's WorkBench and supports both DOS and OS/2; it requires 640K of RAM and about 5MB of disk space. What may particularly interest you about this one is its native support for running FORTRAN applications under Windows 3.0.

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IBM offers the FORTRAN 77 Professional Compiler and Library (IBM, Old Orchard Rd., Armonk, NY 10504; 800-426-2468, 914-765-1900; $715), which requires only 192K of RAM and includes compile-time options for debugging. IBM's FORTRAN Compiler ($350) adds support for OS/2 development.

Finally, Lahey Computer Systems (P.O. Box 6091, Incline Village, NV 89450; 800-548-4778, 702-831-2500) has a number of FORTRAN compilers. Its F77L-EM/32 ($1,390) is a full 32-bit compiler that comes with the OS/386 DOS Extender and requires a 386SX machine or better. The F77L-FORTRAN compiler ($595) works under real mode but also generates 32-bit instructions. The Lahey Personal FORTRAN 77 compiler is probably best for students: It's limited to program executables of 64K or less, but it's inexpensive, retailing for only $99.

On the COBOL front, Microsoft checks in with the Microsoft COBOL Optimizing Compiler ($900), which has the same features as its FORTRAN compiler, including DOS, Windows, and OS/2 support. IBM also offers its COBOL Compiler ($700), which includes an interactive symbolic debugger and supports both DOS and OS/2 development.

One of the more popular DOS-based COBOL compilers is Realia COBOL (Computer Associates International, 711 Stewart Ave., Garden City, NY 11530; 800-645-3003, 516-227-3300; $995). It supports several COBOL dialects, including IBM VS COBOL II, ANSI-85, and ANSI-74, and you can use it to write programs for DOS or OS/2. It requires 270K of RAM and includes support for DOS 3.1–compatible LANs.

If you anticipate moving your code to different platforms, consider AccuCO-

BOL-85 (AccuCOBOL Inc., 7950 Silverton Ave. #201, San Diego, CA 92126; 800-262-6585, 619-689-7220); the DOS version is $979 and the OS/2 version is $1,155. AccuCOBOL also sells a number of source-compatible compilers for VMS and various UNIX systems.

Liant Software sells the RM/COBOL-85 Development System ($1,250), which requires 256K of RAM and supports both standalone and multiuser applications. A single runtime module is included; additional runtime modules are available for $150 each. There's also Personal COBOL (Micro Focus, 2465 E. Bayshore Rd., #400, Palo Alto, CA 94303; 415-856-4161; $149), an ANSI-74 COBOL interpreter designed especially for students.

A good source for these and other compilers (as well as other programmers' tools) is a mail-order company called Programmer's Connection (7249 Whipple Ave. NW, North Canton, OH 44720; 800-336-1166, 216-494-8715). This company, which supports both U.S. and international customers, publishes a quarterly catalog that includes a number of tech tips about the products it sells.

Speeding Up Slow Systems

Now that I've become accustomed to the speed of the 386 at my office, I find it hard to work with my home computer, an IBM Model 30 equipped with the standard, slow, 20MB hard disk. I generally work with large (around 100K) word processing files at home. Functions such as GoTo and Save seem to take a very long time, although I always keep the hard disk defragmented and as clear of nonessential files as possible.

I'd like to speed up my home machine's performance without spending more than a couple of hundred dollars. Can you recommend disk-caching software or a speed-up board?

Michael R. Rochelle
Dallas, Texas

▶PC MAGAZINE A software disk cache is one of the easiest ways to increase hard disk performance on any computer system. The principle on which it works is simple: The cache creates an area in the system's RAM to buffer data read from the hard disk. In most cases the cache will also "read ahead" on the disk, loading whole tracks of data at a time. The odds are that future data requests will require some or all of the data that's already in the cache area, which can be accessed at the faster RAM speed instead of the slower hard-disk speed.

Modern disk caches can use conventional, EMS, or extended memory (or some combination of the three) as their work area. The more RAM you can give to the cache, the greater the improvement you'll see in disk performance.

If you have MS-DOS 5.0 or Windows 3.0, you already have a basic disk cache on your disk—the SMARTDRV.SYS program that's included with every copy.

A software disk cache is one of the easiest ways to increase hard disk performance on any computer system.

Just add the line "DEVICE=C:\DOS\SMARTDRV.SYS" to your CONFIG.SYS file (adapting it, of course, to refer to the directory on your disk where SMARTDRV.SYS resides), and reboot your system. You'll see a difference the next time you access your hard disk from your word processor. The DOS and Windows manuals explain the command line options SMARTDRV uses to control the size of the cache and to specify which memory it uses.

Super PC-Kwik (Multisoft Corp., 15100 SW Koll Pkwy., Beaverton, OR 97006; 800-288-5945, 503-644-5644; $79.95) is one of the better-known commercial disk cache packages; it was included in the article "The Ultimate Utility Shelf" in the June 26, 1990, issue of *PC Magazine*. DR DOS 6.0 comes with a licensed copy of Super PC-Kwik, and many system vendors include a copy with their systems. Other commercial disk caches include Lightning (DacEasy Inc., 17950 Preston Rd., #800, Dallas, TX 75252; 800-322-3279, 214-248-0205; $49.95) and VCache (Golden Bow Systems Inc., 842 E. Washington St., Suite B, San Diego, CA 92103; 800-284-3269, 619-298-9349; $69.95).

I've also heard many favorable comments about Hyperdisk (Hyperware, Rt. #1, Box 91, Pall Mall, TN 38577; 615-864-6868; $49 noncommercial, $69 commercial, plus $5 shipping), a shareware disk cache with versions for 8088, 286, and 386 CPUs. You can download Hyperdisk from Hyperware's BBS at 615-864-6871, or from Library 10/Windows of the PC MagNet Utilities/Tips Forum (see page 12 for details on joining PC MagNet).

In addition to a disk cache, you can speed up your whole system with an accelerator card, which replaces your existing CPU with a faster one. If your Model 30 is 80286-based, you have a couple of choices. AOX Inc. (486 Totten Pond Rd., Waltham, MA 02154; 800-726-0269, 617-890-4402) sells two different modules that snap into the 286's chip socket and upgrade the computer to an 80386SX CPU. The 16-MHz version lists for $279 and the 20-MHz version for $379.

The FASTCache-SX Plus-25 (Micro Way Inc., P.O. Box 79, Research Park, Kingston, MA 02364; 508-746-7341; $595) is an add-on card that upgrades your system with a 25-MHz AMD-386SX chip and a 16K CPU Cache. A cable (which will cost you an additional $95) runs from the card to the 80286 socket to connect it to the system. The card has sockets for up to 16MB of RAM, so you can upgrade your memory as well.

If you have the 8086 version of the Model 30, you're out of luck; I couldn't find any accelerator cards that work with it. Unfortunately, a replacement motherboard is out of the question for either version of the Model 30 because of its slim design, which has the adapter slots sitting sideways on a daughterboard attached to the existing motherboard. □

ASK THE ADVISOR

Send your question to PC Advisor, One Park Ave., New York, NY 10016, MCI mailbox PC MAGAZINE, or upload it to PC MagNet (see the instructions for joining on page 12 of this issue). We regret that we are unable to acknowledge submissions or answer letters individually.

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Stan Miastkowski BYTE Magazine, April 1992

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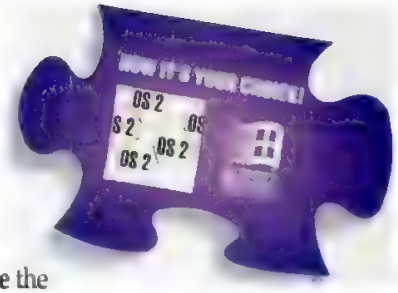

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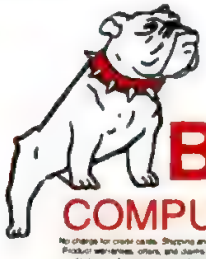

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TUTOR

Optimizing Your Configuration: A line-by-line analysis of a typical CONFIG.SYS file helps you get the most out of your system.

BY JEFF PROSISE

Optimizing Your Configuration

I have a new 33-MHz 486 machine with 4MB of RAM but still don't seem to have enough memory to execute large application programs. In fact, despite running DOS 5.0, which I thought should make even more RAM available, I keep getting "insufficient memory" messages. I've enclosed a copy of my CONFIG.SYS file. What am I doing wrong?

Fel Lorek
Niagara Falls, New York

▶**PC MAGAZINE** You're not doing anything wrong that a few minor changes to your CONFIG.SYS (see Figure 1) won't cure. In fact, the mistakes you've made are pretty typical. I receive many letters from users trying to tweak DOS 5.0 to maximize available memory. Sometimes the attempts can backfire, though. To illustrate, we'll analyze your CONFIG.SYS line by line and demonstrate how a few simple changes can make a world of difference in the amount of memory available to applications.

• Line 1:

```
DEVICE=C:\DOS\HIMEM.SYS
 /INT15=65535
```

HIMEM.SYS, DOS 5.0's XMS (extended memory specification) driver, provides a generally agreed-upon means for programs for cooperatively accessing upper memory, extended memory, and the region of extended memory known as the high memory area, or HMA. HIMEM.SYS must be installed in order to load DOS into the HMA, to place TSRs and device drivers in upper memory, and to let XMS-aware programs such as SMARTDrive use extended memory.

There are problems, though, with the use of HIMEM.SYS here. The /INT15 switch reserves the specified amount of extended memory for programs accessing extended memory in the old way, via the ROM BIOS's interrupt 15h extended memory services. Memory set aside like this cannot be used by HIMEM.SYS or programs that handle extended memory according to XMS conventions. Furthermore, the number following /INT15 specifies *kilobytes*, not bytes. Thus, CONFIG.SYS tries to reserve 65,535K—65MB—of RAM, which would effectively prevent HIMEM.SYS from using any extended memory at all. Fortunately, HIMEM.SYS fails the attempt because your system contains only 4MB, not 65MB. If the intent was to set aside 65,535 bytes (64K) of RAM for interrupt 15h, then the switch should be changed to /INT15=64. If none of your programs require raw extended memory, you may delete the /INT15 switch altogether.

• Line 2:

```
DEVICE= C:\DOS\RAMDRIVE.SYS /A
```

RAMDRIVE.SYS is DOS 5.0's RAM-disk driver. There's nothing wrong with loading a RAM disk, but /A says you intend it to use expanded memory. The trouble is that the line invoking RAMDRIVE comes before the one that loads EMM386.EXE, and until EMM386 runs, there *is* no expanded memory.

Watch your screen closely at startup when RAMDRIVE is loaded this way. You should see the driver display a message that reads "Expanded Memory Manager not present." As a rule, any driver that uses expanded memory must be loaded *after* the line that installs the expanded memory manager—EMM386.EXE, in this case. So you should swap lines 2 and 3.

Swapping these two lines provides an additional benefit. When you invoke EMM386 before RAMDRIVE, you can replace DEVICE (which is the command loading RAMDRIVE.SYS) with DEVICEHIGH, which will move the driver to upper memory. If RAMDRIVE.SYS is loaded before EMM386.EXE, the RAM-disk driver must go in conventional memory.

There's an even bigger issue that we need to consider here. RAMDRIVE.SYS will readily use conventional, extended, or expanded memory. When you have the choice of using extended memory managed by HIMEM.SYS or expanded memory created from extended memory with EMM386.EXE, it's much more efficient to use extended. Unless your PC contains an expanded-memory board, you should install RAMDRIVE.SYS with the /E switch rather than the /A switch, as shown below:

```
DEVICEHIGH=C:\DOS
 RAMDRIVE.SYS 360 /E
```

This statement relocates the driver itself to upper memory and creates a 360K RAM disk in extended memory (instead of the 64K you get if you don't specify a size).

• Line 3:

```
DEVICE=C:\DOS\EMM386.EXE
```

Properly configured, EMM386.EXE performs two important services. First, it provides upper memory blocks (UMBs) that DOS 5.0's LOADHIGH and DEVICEHIGH commands use for loading TSRs and device drivers. Second, it con-

verts some or all of the extended memory in your system to EMS 4.0 expanded memory, which provides support for programs that can use expanded but not extended memory. It does both, however, only if you install it with a RAM parameter, as in

```
DEVICE=C:\DOS\EMM386.EXE RAM
```

Furthermore, if you don't specify how much expanded memory EMM386.EXE should make available, it defaults to 256K—which is too little under most circumstances to be of value. Better to tell it how much expanded memory to create so that you know exactly what you're getting. The statement

```
DEVICE=C:\DOS\EMM386.EXE RAM 2048
```

configures EMM386 to make UMBs available and provide 2MB of expanded memory to EMS-aware programs. Note that you may instruct EMM386.EXE to provide UMB support without EMS support by replacing the RAM parameter with NOEMS.

• Line 4:

```
DEVICEHIGH=C:\DOS\SETVER.EXE
```

There are two things wrong with this statement. First, in the original setup SETVER.EXE won't be loaded in upper memory because EMM386.EXE isn't configured to provide UMB support. Second, SETVER is unnecessary on most PCs and only winds up using valuable memory.

DOS 5.0's installation program places the program in CONFIG.SYS by default. Type SETVER at the command prompt to get a list of the programs and drivers that SETVER.EXE supports. If you don't use any of them, remove SETVER.EXE from your CONFIG.SYS file. Otherwise, change line 3 as described in the preceding paragraphs to load SETVER high.

• Line 5:

```
DEVICEHIGH=C:\DOS\SMARTDRV.SYS
```

SMARTDRV.SYS (also known as SMARTDrive) is DOS 5.0's disk-caching driver. It enhances hard disk performance by storing drive data in RAM where the information can be accessed much more quickly than from the hard disk. SMARTDrive also extends hard disk life by reducing damaging wear and tear.

As the line stands, SMARTDrive will be loaded low rather than high because EMM386 is improperly configured. This robs your applications of about 20K of conventional memory. Adding the RAM parameter described above will correct that. And, since you failed to specify a cache size, SMARTDrive will create only a 256K disk cache. On a system with 4MB of RAM, you can easily afford a more spacious cache. A better way to load SMARTDrive is

```
DEVICEHIGH=C:\DOS\SMARTDRV.SYS 512
 256
```

This doubles the cache size to 512K and also allows programs such as Windows to borrow up to 256K from the cache if needed.

Be aware that it is not safe to load SMARTDrive into upper memory on all 386 and 486 systems.

Be aware that it's not safe to load SMARTDrive in upper memory on all 386 and 486 systems, though. Some ESDI and SCSI controllers use *bus mastering*—a technique that takes control of the bus in order to access RAM directly, allowing faster data transfer. If your machine incorporates a controller that doesn't support Microsoft's Virtual DMA Services (VDS) protocol, loading SMARTDrive high may corrupt the data going to and from the hard disk. Most systems are fine, however.

The new version of SMARTDrive shipped with Windows 3.1 takes care of the problem by using a technique called *double buffering*, which places SMARTDrive's track buffers in conventional memory even when the rest of SMARTDrive is loaded high. If you've used the old SMARTDrive (Version 3.*x*) in upper memory before without experiencing problems, chances are you're okay.

• Line 6:

```
DOS=HIGH,UMB
```

There's nothing wrong here. DOS=HIGH loads DOS in the HMA, freeing up as much as 60K of conventional memory for programs to use. DOS=UMB turns UMBs created by EMM386 over to DOS so they can be used by its LOADHIGH and DEVICEHIGH commands. Currently, though—with EMM386 lacking either a RAM or a NOEMS parameter—the UMB qualifier is meaningless. Once you make the modification I have described above to the line that loads EMM386.EXE, DOS=UMB will have the intended effect.

• Line 7:

```
BREAK=ON
```

DOS understands Ctrl-C and Ctrl-Break to mean that you want to halt the ongoing operation. By default, however, DOS only checks for presses of these keys when it writes a character to the screen, serial port, or printer, or when it reads the keyboard. The statement BREAK=ON extends break checking so that DOS will check for these key presses more often (for example, when it reads and writes disk files). The downside to including this statement is that it slows down file operations, albeit ever so slightly. Unless you have a specific reason for including the statement, delete it.

• Line 8:

```
FILES=40
```

In DOS 5.0, each slot you reserve in the system file table with the FILES= statement requires 59 bytes of conventional memory. It's to your advantage to minimize the size of the system file table to the greatest extent possible. (For more on the system file table, see the November 12, 1991, Tutor column.) On a 386 or 486 machine configured to load programs into UMBs, the easiest way to do this is to use *PC Magazine*'s UMBFILES utility to transfer the system file table to upper memory. (See the November 26, 1991, Utilites column; you can download UMBFILES from PC MagNet.)

In this case, you'd change FILES=40 to FILES=8 in CONFIG.SYS and add

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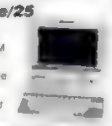

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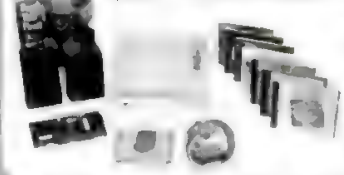

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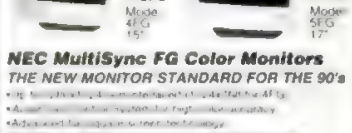

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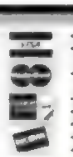

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CIRCLE 189 ON READER SERVICE CARD

The Original CONFIG.SYS File

```
DEVICE=C:\DOS\HIMEM.SYS /INT15=65535
DEVICE=C:\DOS\RAMDRIVE.SYS /A
DEVICE=C:\DOS\EMM386.EXE
DEVICEHIGH=C:\DOS\SETVER.EXE
DEVICEHIGH=C:\DOS\SMARTDRV.SYS
DOS=HIGH,UMB
BREAK=ON
FILES=40
BUFFERS=40
LASTDRIVE=Z
```

***Figure 1:* A system setup with this CONFIG.SYS file uses a lot more RAM than it needs to.**

The Modified CONFIG.SYS File

```
DEVICE=C:\DOS\HIMEM.SYS
DEVICE=C:\DOS\EMM386.EXE RAM 2048
DEVICEHIGH=C:\DOS\RAMDRIVE.SYS 360 /E
DEVICEHIGH=C:\DOS\SMARTDRV.SYS 512 256
DOS=HIGH,UMB
FILES=8
BUFFERS=10
LASTDRIVE=H
STACKS=0,0
REM  Don't forget to add
REM  UMBFILES=32 to AUTOEXEC.BAT
```

***Figure 2:* By incorporating the suggested changes in the CONFIG.SYS file, far more RAM is made available to the system.**

the command UMBFILES=32 to your AUTOEXEC.BAT file, yielding more free RAM in the lower 640K region of memory.

• Line 9:

```
BUFFERS=40
```

Although BUFFERS=40 requires no more conventional memory than BUFFERS=10 when DOS is loaded in the HMA, you don't need a high BUFFERS setting if you're using SMARTDrive. In fact, a high BUFFERS count can actually impede hard disk performance with SMARTDrive loaded. For good measure, set BUFFERS equal to 10 and increase it only if you observe a decrease in floppy disk drive performance.

• Line 10:

```
LASTDRIVE=Z
```

For every logical drive defined in your system, DOS sets aside 88 bytes of conventional memory to store information associated with the drive (see the discussion of current directory structures in the August 1991 Tutor column for a detailed explanation). By default, DOS reserves room for either five drives (A: through E:) or the number of logical drives present in your system, whichever is greater. The LASTDRIVE statement lets you reserve room for more logical drives by specifying the highest drive letter DOS should support. It's most commonly used to reserve space for additional logical drives created with the SUBST command or network utilities.

Setting LASTDRIVE equal to Z wastes memory unless you've defined 26 logical drives (drive letters A through Z). It's better to count the number of logical drives and assign them contiguous drive letters, and then to set LASTDRIVE to the highest letter you need. For example, suppose you have two floppy drives (A: and B:), a hard disk partitioned into logical drives C:, D:, and E:, and a RAM disk that assumes the letter F:. Furthermore, suppose your AUTOEXEC.BAT file contains the statements

```
SUBST M: C:\DOS
SUBST Z: D:\WINDOWS
```

In this case, you could save about 1.5K of RAM by changing LASTDRIVE=Z to LASTDRIVE=H and altering the SUBST commands in AUTOEXEC.BAT to read

```
SUBST G: C:\DOS
SUBST H: D:\WINDOWS
```

If other commands in your AUTOEXEC.BAT file reference these drive letters—such as a PATH command or commands that load TSRs—take care to modify those, also.

• Line 11:

```
STACKS=0,0
```

Notice that there *is* no line 11 in Figure 1. You should add one, though, and here's why: System crashes occasionally result when too many hardware interrupts occur in too short a time. To prevent this, DOS intercepts selected hardware interrupts and assigns them stack space from a pool of system stacks maintained internally. (A *stack* is an area of memory where an interrupt handler saves data necessary to restore the system to the state it was in when the interrupt occurred).

On most systems, this is unnecessary. But on a 286 or later, DOS defaults to the equivalent of STACKS=9,128, robbing the system of more than 1K of RAM. The statement STACKS=0,0 eliminates these internal stacks, returning that RAM to your applications. If adding this statement results in "Internal stack overflow; system halted" messages from DOS, remove it from CONFIG.SYS and reboot.

Figure 2 shows the modified CONFIG.SYS file that incorporates the suggestions outlined above. EMM386.EXE is now loaded with a RAM parameter and configured to provide 2MB of expanded memory as well as UMB support to DOS. RAMDRIVE.SYS and SMARTDRV.SYS are loaded high, and RAMDRIVE is configured to use extended rather than expanded memory for data storage.

The FILES setting has been decreased from 40 to 8 (but don't forget to put a UMBFILES=32 command in your AUTOEXEC.BAT file). LASTDRIVE is now set to H, though of course the proper setting varies from PC to PC. Finally, STACKS=0,0 recovers the RAM that DOS devotes to internal stacks. The result? The modified CONFIG.SYS file gives you about 25K more free RAM in the lower 640K than you had before. And this figure can go even higher if your AUTOEXEC.BAT uses LOADHIGH commands to load TSRs. In the old configuration, they could only be loaded low.

For more information on CONFIG.SYS amd memory managment see the sidebar "The Ultimate Tricksters: How DOS Memory Managers Work" in this issue's software feature "Optimizing for the Perfect PC." □

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The Tutor solves practical problems and explains techniques for using your hardware and software more productively. Questions about DOS and systems in general are answered here. Send your question to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see page 10 for instructions). We regret that we can't acknowledge submissions or answer questions individually.

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USER-TO-USER

User-To-User Expands!: Now we'll cover tips on DOS *and* Windows A FOR Command Quirk: How to split off the first character of any environment variable

BY NEIL J. RUBENKING

User-To-User Expands!

Since I began editing User-to-User in 1988, I've received hundreds of letters each month from you, *PC Magazine*'s readers, sharing what you've learned about DOS. Though many items are duplicates, I'm always amazed at the number of new ideas and new twists on old ideas. It's quite clear that DOS is far from moribund!

These days, though, more and more of you are working in Windows or dividing your time between DOS and Windows. From now on, User-to-User will welcome your tips for using both DOS *and* Windows. Windows is just plain perplexing sometimes; if you discover new ways to bring order to that complexity, send them in!

The best submissions from our readers are fueled by enthusiasm and a sense of fun. In that spirit, I'd like to introduce this column's coverage of Windows by sharing some surprising features of Windows that you've probably never seen invoked. It's like following a sorcerous spell: A seemingly pointless set of actions yields a startling result. Ready?

In Windows 3.1, bring up the Program Manager. Hold down the Shift and Ctrl keys, and repeat the following steps three times:

- Select About from the Help menu.
- Double-click on one of the four panes of the Windows 3.1 icon in the About dialog box.
- Close the About dialog box.

The second time you repeat the steps, you'll see a flag waving—something must be happening! The third time, a scrolling list of the many people involved in creating Windows 3.1 appears, announced by one of several pictured figures. One figure is a bear; the rest resemble certain Microsoft executives.

I don't want Windows 3.0 users to feel left out, so here's a similar (if less elaborate) trick for you. Hold down the F3 key, successively tap the four keys W, I, N, 3, release F3, and press Backspace. Your desktop background will be replaced by a list of Windows 3.0's creators. Click on the background to get rid of the list.

Of course, most of the tips and tricks we'll deal with will be more useful than these. They'll be inspired, I expect, by the same zest our readers have always shown for uncovering the hidden ways to make systems work better.

A FOR Command Quirk

The FOR batch command has a very useful quirk: If you precede a FOR command variable with a slash (/), DOS interprets that variable as two variables. The first variable is the first character of the original variable, and the second is all the remaining characters. There are several ways to put this to use. For example, you can branch to another program based on the first character of a batch file parameter. Use a command like this:

```
FOR %%y in (/%1) DO IF %%y==B
PROGRAMB
```

GETLNGTH.BAT

Complete Listing

```
@ECHO OFF
Rem  ### Get the length of Environment Variable STRING,   ###
Rem  ### set to the value of %1 on entry. Set the length  ###
Rem  ### in Environment Variable LENGTH. Lengths greater  ###
Rem  ### than nine characters set LENGTH equal to 9+.     ###
Rem  ### Variable STRING may not include the  character. ###
SET string=%1
IF '%string%'==='' GOTO zero
SET temp=%string%~
SET length=
:loop
SET length=+%length%
FOR %%y IN (/%temp%) DO SET temp=%%y
IF NOT %temp%==~ GOTO loop
IF %length%==+ SET length=1
IF %length%==++ SET length=2
IF %length%==+++ SET length=3
IF %length%==++++ SET length=4
IF %length%==+++++ SET length=5
IF %length%==++++++ SET length=6
IF %length%==+++++++ SET length=7
IF %length%==++++++++ SET length=8
IF %length%==+++++++++ SET length=9
FOR %%z IN (/%length%) do if %%z==+ SET length=9+
GOTO done
:zero
SET length=0
:done
SET temp=
ECHO Length of "%string%" is %length%
```

Figure 1: **This batch file uses a quirk of the FOR command to calculate the length of whatever text string you pass to it.**

```
FOR %%y in (/%1) DO IF %%y==b
PROGRAMB
```

Or you can determine the length of a string stored as an environment variable as shown in GETLNGTH.BAT, which is listed in Figure 1.

Dave Graczyk
East Amherst, New York

▶PC MAGAZINE The stated purpose of the slash character in FOR loops is to prevent FOR from expanding wildcard characters; for example,

```
FOR %%f IN (H h /?) DO IF
 '%1'=='%%f' GOTO Help
```

A batch file that uses the line above will execute the code at the label Help if the first command line parameter is *H*, *h*, or *?*. Without the slash, the FOR command would attempt to replace the question mark with a list of all files that had one-character filenames and no extensions, and would thus fail to recognize the command line parameter *?*.

The most important line in GETLNGTH.BAT is this one:

```
FOR %%y IN (/%temp%) DO SET
 temp=%%y
```

The FOR command treats /%temp% as a list with two values, one of them the first character in %temp% and the other the string with the first character removed. It sets temp to each of these values in turn, so after this loop finishes, temp has lost its first character. GETLNGTH initially adds a tilde (~) to the end of temp and loops until only the tilde is left, adding a plus sign (+) to the initially empty length variable on each repetition.

After the loop, the length variable contains as many plus signs as there were characters in the original string. A series of comparisons sets the length variable to a number 1 through 9 *if* the number of plus signs is 9 or fewer. After these tests, the batch file uses the FOR-and-slash technique again, to set length to 9+ if it wasn't set to any other number.

With a little more work, you can chop the first character from an environment variable and keep both the character and the remaining string—and that ability is the basis for some powerful string manipulation. I wrote the batch file REVERSE.BAT (Figure 2) to reverse a string using the FOR-and-slash technique.

REVERSE.BAT
Complete Listing

```
@ECHO OFF
IF '%1'==''' GOTO Syntax
IF NOT '%2'==''' GOTO Syntax
SET WString=%1
SET rev=
:loop
SET OldVal=%WString%
FOR %%v IN (/%WString%) DO SET WString=%%v
FOR %%v IN (/%OldVal%) DO IF '%%v%WString%'=='%OldVal%' SET first=%%v
IF NOT '%OldVal%'=='%WString%' GOTO NotLast
SET rev=%OldVal%%rev%
GOTO Done
:NotLast
SET rev=%first%%rev%
GOTO loop
:Syntax
ECHO Syntax: REVERSE string
ECHO where string is a character string with no spaces.
GOTO End
:Done
ECHO "%1" reversed is "%rev%"
SET WString=
SET OldVal=
SET first=
:END
```

***Figure 2:* This batch file strips characters from the front of its input string one at a time and uses them to build a reversed copy of that string.**

REVERSE.BAT starts by ensuring that there is precisely one command line parameter. If that's not the case, it jumps to the label Syntax and exits. If there is one command line parameter, it sets the environment variable WString to the command line parameter, clears the variable rev, and enters the main loop.

Each time through the loop, the batch file sets the environment variable OldVal to the current value of WString. The initial FOR loop chops the first character from WString, just as in GETLNGTH .BAT. The second FOR loop splits the *old* value of WString into its first character and the remainder, and sets the environment variable first to that first character. After the two loops, if WString and OldVal don't have the same value, control transfers to the label NotLast. The batch file prefixes the variable front to the current value of rev and assigns the result to rev.

This loop continues until WString is down to a single character. At that point, the two FOR loops do not change WString, and WString and OldVal will be equal. The batch file prefixes that single remaining character to the rev variable and jumps to the label Done. At that label, it displays the initial string and its reverse, and cleans up the temporary environment variables.

Batch File Calculation

The September 10, 1991, Utilities column presented STRINGS.COM, by Douglas Boling, a program for expanding batch file versatility. I needed a program to do some calculations and was about to write one in BASIC, since I figured it would be too messy to do in a batch file. Then I read the article about STRINGS and wrote a batch routine instead, avoiding the need for BASIC.

Since STRINGS' arithmetic functions don't handle decimals or negative quantities, I developed three batch files to handle decimals: ADD.BAT, MUL.BAT, and DIV.BAT. ADD.BAT (Figure 3) is an algebraic adder in that it will accept a minus sign, so it effectively handles subtraction, too.

The speed of these batch files isn't great, but for the occasional calculation I need to do while in DOS, I find it more convenient than loading BASIC or hunting down a calculator.

Robert C. Marcus
St. Thomas, Ontario, Canada

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CIRCLE 145 ON READER SERVICE CARD

ADD.BAT

Complete Listing

```
%0%echo off
cls
if %1!==! goto instr
echo Calculations are in PROGRESS!
set num1=%1
set num2=%2
strings sign1 = left %1,1
if  not %sign1%==- goto cont1
strings num1 = mid %num1%,2,128
:cont1
strings /p decpos1 = find %num1%.
if not %decpos1%==0 goto havdec1
goto gettwo
:havdec1
strings decpos1 = add %decpos1%,1
strings dec1 = mid %num1%,%decpos1%,128
strings decpl1 = length %dec1%
strings decpos1 = sub %decpos1%,2
strings num1 = left %num1%,%decpos1%
set num1=%num1%%dec1%
:gettwo
strings sign2 = left %2,1
if not %sign2%==- goto cont2
strings num2 = mid %num2%,2,128
:cont2
strings /p decpos2 = find %num2%.
if not %decpos2%==0 goto havdec2
goto chkdp1
:havdec2
strings decpos2 = add %decpos2%,1
strings dec2 = mid %num2%,%decpos2%,128
strings decpl2 = length %dec2%
strings decpos2 = sub %decpos2%,2
strings num2 = left %num2%,%decpos2%
set num2=%num2%%dec2%
:chkdp1
strings sub %decpl1%,%decpl2% > nul
if not errorlevel 1 goto chkdp2
strings num1 = mul %num1%,10
strings decpl1 = add %decpl1%,1
goto chkdp1
:chkdp2
strings decpl = sub %decpl1%,%decpl2%
if %decpl%==0 goto addition
strings num2 = mul %num2%,10
strings decpl2 = add %decpl2%,1
goto chkdp2
:addition
if %sign1%==- goto chg1
set sign1=
:chk2
if %sign2%==- goto chg2
set sign2=
goto moreadd
:chg1
set sign1=1
goto chk2
:chg2
set sign2=1
:moreadd
strings sign = add %sign1%,%sign2%
if not %sign%==0 if not %sign%==2 goto subtract
strings answer = add %num1%,%num2%
:getdecprt
strings decprt = right %answer%,%decpl1%
strings len = length %answer%
strings intlen = sub %len%,%decpl1%
strings int = left %answer%,%intlen%
set answer=%int%.%decprt%
if %sign2%!==! set sign2=+
if .%sign2%==.1 set sign2=
if %sign%==2 set mark=-
echo %1%sign2%%2 = %mark%%answer%
goto end
:subtract
strings answer = sub %num1%,%num2% > nul
if errorlevel 1 goto otherway
if .%sign1%==.1 set mark=-
goto getdecprt
:otherway
strings answer = sub %num2%,%num1%
if .%sign2%==.1 set mark=-
goto getdecprt
:instr
echo + -
+ - + - + - + - + - + - + - + - + - + - + - + - + - + - + - + - + - + - + - + - + - +
echo.
echo       ALGEBRAIC   ADDITION  (minus signs accepted)
echo.
echo             Enter the numbers you wish to add after %0:
echo.
echo                      such as: ADD  3.57  5.75
echo                               ADD -3.57 -5.75
echo                               ADD  3.57 -5.75
echo                               ADD -3.57  5.75
echo.
echo    (Remember, subtracting negative numbers the sign is changed.)
echo.
echo + -
+ - + - + - + - + - + - + - + - + - + - + - + - + - + - + - + - + - + - + - + - + - +
:end
set num1=
set dec1=
set decpl1=
set decpos1=
set sign1=
set num2=
set dec2=
set decpl2=
set decpos2=
set sign2=
set sign=
set mark=
set answer=
set decpl=
set decprt=
set len=
set int=
set intlen=
echo.
echo.
```

Figure 3: **ADD.BAT uses the STRINGS utility to add or subtract numbers with decimal points.**

▶PC MAGAZINE Mr. Marcus has vastly increased the utility of the math functions in STRINGS.COM by letting them work on numbers that have decimal points. STRINGS alone will add, subtract, multiply, and divide whole numbers, but real-world problems often go beyond integers. You are more likely to calculate 8.25% of $39.95 than you are to add 2 and 2! For reasons of space, we could not print MUL.BAT or DIV.BAT, but you can download all three batch files from PC MagNet.

These batch file enhancements to STRINGS do require a fair amount of environment space for their many variables. If you get an "out of environment space" message when running them, you can enlarge your basic environment by adding a SHELL= statement to your CONFIG.SYS file. The main purpose of the SHELL= directive is to inform DOS of the precise location of the command shell program that you want to use, but you can add the /E parameter to specify the environment size. In DOS 3.2 and later, you simply indicate the number of bytes you want the environment to have. For example, a line like

```
SHELL=C:\DOS\COMMAND.COM
 C:\DOS/E:512 /P
```

will give you a 512-byte environment. □

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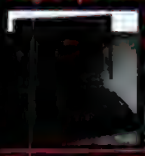

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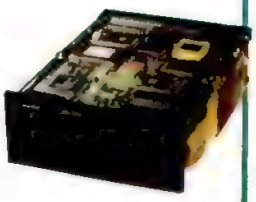

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SPREADSHEETS

Excel Shortcut Keys: Perform common spreadsheet tasks quickly Saving Unnamed 1-2-3/W Files: A macro that pops up a Save As dialog when saving an unnamed worksheet

BY CRAIG STINSON

Mixed Millennia

The year 2000 is coming up fast. The designers of *Quattro Pro* have given the turn of the century some thought, but not enough. Dates before 2000 are displayed with only two digits in the year. You don't get a choice. Dates after 1999 are displayed with four digits in the year. Again, you don't get a choice. Mixing dates from both centuries in the same column looks messy.

So, instead of one column for a date, use two. Make the first column 1 character wide and the second column 11 characters wide. Use the first column for entering dates and the second for displaying the dates entered in the first column.

To enter a date, just position the cursor in that narrow column and enter the date normally. Each relevant row of the second column should contain a string formula that references the cell to its left. For example, here's how the formula would look at cell B1:

```
@IF(@CELL("type",A1)="b","",
@RIGHT(@STRING(@MONTH(A1)+100,0),
2)&"/"&@RIGHT(@STRING(@DAY(A1)
+100,0),2)&"/"&@STRING(@YEAR(A1)
+1900,0))
```

You only need to enter this formula once; after that you can copy it anywhere you need it, even into other columns immediately to the right of other "real" date columns.

William J. Evans
Irvine, California

▶**PC MAGAZINE** Mr. Evans's formula does take care of a formatting limitation in Borland's Quattro Pro 3.0 and all current versions of Lotus 1-2-3. The formula converts each component of a date into text and then chains all the pieces together, along with a couple of slash characters. You can substitute hyphens for the slashes if you prefer them, and eliminate the +100 in both places if you want single-digit months and days (06/01/1992, for example) to appear without the leading zeros.

Because the formula's result is text, you won't be able to reference the formula cell for date arithmetic. But that's no problem; just reference the cell to the left—the one where you actually entered the date.

In addition to the bother of entering this formula, Mr. Evans's suggestion imposes a bit of recalc overhead on your spreadsheet. If you have upgraded to Quattro Pro 4.0, you can solve the problem in a more efficient way by creating a named style that includes a custom date format. For example, if you define a format that looks like this:

```
T mm/dd/yyyy
```

Quattro Pro 4.0 will always use four digits for the year. (Note that the *T* is required to let Quattro Pro know that the format represents a daTe or Time.) You can also create custom date formats that spell out the month or that add the day of the week.

The menu node where you create the custom format is tucked away under /Style Define Style Create. You have to start by telling Quattro Pro that you want to create a new defined style. After this, you need to supply a name for the style, then choose Numeric Format User Defined, and then fill out a dialog box with your new format. You can also apply other formatting attributes—shading, underlining, and font information, for example—to your new named style.

Once you have created the new named style, you can apply it using the /Style Use Style command. If you've named your date format LONGDATE, for example, that name will appear in a dialog box (along with any other named styles you've created and a handful of styles predefined by Borland) every time you issue the /Style Use Style command.

Excel Shortcut Keys

Dale Arndt's macro for a date-and-time stamp (March 31, 1992) is a nice piece of Excel code, but in my experience, I've found it quicker and easier to enter the date by typing Ctrl-; and the time by typing Ctrl-:. For some reason, these shortcuts—which enter the date and time as properly formatted values—were not documented in the Excel 3.0 manual, but I remember them from some version long past. I have been using them at least since Version 2.1.

Another undocumented shortcut is Ctrl-', which copies the contents of the cell above the active cell into the active cell. This is different from the standard Edit Copy command because it copies exactly, without adjustment of relative references. To get the equivalent of Ctrl-' with menu commands, you'd have to select the cell above, press F2 to edit the formula, select the entire formula, do an Edit Copy, press Esc to leave the formula bar, select the cell below, and then do an Edit Paste. I find the shortcut really helpful when I'm debugging a long formula and want to experiment with subsets of the formula.

Duke Carey
Columbus, Ohio

Excel Shortcut Keys

Data Entry	
Ctrl-;	Enter current date on formula bar
Ctrl-:	Enter current time on formula bar
Ctrl-"	Copy value from cell above
Ctrl-'	Copy formula from cell above
Alt-=	Autosum
Ctrl-Enter	Fill selection with current formula
Shift-F3	Paste function
Ctrl-A	Paste arguments into current function (new with *Excel* 4)
Editing	
Alt-Enter	Repeat last action
Alt-Backspace	Undo
Ctrl-Z	Undo (new with *Excel* 4)
Ctrl-R	Fill right (new with *Excel* 4)
Ctrl-D	Fill down (new with *Excel* 4)
Ctrl-X	Cut (new with *Excel* 4)
Ctrl-C	Copy (new with *Excel* 4)
Ctrl-V	Paste (new with *Excel* 4)
Files	
F11	Open new chart
Ctrl-F11	Open new macro sheet
Ctrl-F12	Open file
Shift-F12	Save file

Figure 1: **Here's a sampling of 20 of the most useful Excel shortcut keys.**

►PC MAGAZINE Mr. Carey is right. The Ctrl-; and Ctrl-: shortcuts obviate the need for date-and-time stamping macro code. You can also use Ctrl-: just to get the time of day; nothing is written into the current cell if you press Esc.

Microsoft has improved its documentation of keyboard shortcuts with the latest version of Excel. Unfortunately, there are so many shortcuts that the Excel 4.0 manual requires 19 pages to tabulate them. They're all valuable, no doubt, especially if you're using Excel on a portable computer without an effective pointing instrument. But how many people would want to memorize 19 pages of shortcuts?

The table in Figure 1 presents my own personal selection of 20 of Excel's most valuable shortcuts. I've chosen them either because they are easy to remember (for example, Ctrl-Backspace performs an Undo) or because they're particularly worth the trouble to learn, even though they are not especially memorable. Alt-=, for example, does the equivalent of clicking the mouse pointer on the Autosum button—not obvious, but certainly worth learning if your mouse goes in for repairs.

Saving Unnamed 1-2-3/W Files

I've written a simple macro that remedies an annoying feature of 1-2-3 for Windows. In 1-2-3/W, when a new spreadsheet is created, it is given a name like FILE0000.WK3. I find this bothersome because the names later have to be changed. But by then, my files have been saved and I have many FILE*xxxx*.WK3 files cluttering up the default data directory. What Lotus should have done is have a Save As dialog appear when one of these files is being used.

I have written a Save macro that does just that, and I put it in my AUTO-123.WK3 file so it is loaded every time I start 1-2-3. The macro is as follows:

```
\S  {if @left(@cellpointer
    ("filename"),9)="E:\FILE00")
    {alt}fa{quit}
    {alt}fs
    {quit}
```

The macro checks to see whether the name and path equal one of those "FILE*xxxx*" files. If they do, it issues a Save As command, which prompts me to supply a new filename. Otherwise, it performs a normal save. To use the macro, I simply type Ctrl-S—which also happens to be the shortcut for Ami Pro's File Save command.

The macro is set up for my data directory, which is the root directory of drive E. Other users will have to modify the macro for their own directories.

Ross Barclay
Kingston, Ontario, Canada

►**PC MAGAZINE** File saving is only one of the many areas in which Lotus chose to make 1-2-3 for Windows consistent with 1-2-3, Release 3.*x*, rather than with de facto Windows standards. The majority of Windows programs, including others from Lotus, automatically give you a Save As command if you try to save an unnamed file. 1-2-3/W instead saves the file under the current dummy name, which increments from FILE-0000.WK3 on up. Moreover, if you use File New to open additional worksheets, these additional worksheets are automatically assigned dummy names.

I suspect many 1-2-3/W users have directories full of these unwanted children. Mr. Barclay's macro is a fine solution to the problem. To make it work on your system, regardless of what data directory you use, change the {if} statement to read as follows:

```
{if @left(@right(@cellpointer
("filename"),12),5)="FILE0")
```

@cellpointer("filename") returns the current file's full ID, including the path. @right(. . .,12) extracts the filename, the period, and the three-character extension. @left(. . .,5) returns the first five characters of this extract, and the {if} statement checks to see whether those characters are FILE0. □

HINTS, TIP, QUESTIONS

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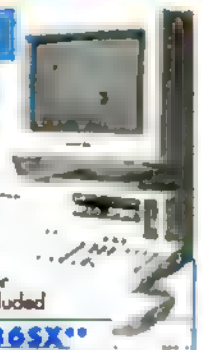

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CIRCLE 294 ON READER SERVICE CARD

THE WORKING WORD

Windows Print Speed: How to print faster in Word for Windows, WordPerfect for Windows, and Ami Pro

BY M. DAVID STONE

Windows Print Speed

One of the most common complaints that people who move from a DOS word processor to Word for Windows have is how slowly WinWord prints. Many users, however, are not aware that certain settings in both Windows and WinWord can influence printing speed. A partial list of these follows.

Before printing, Restore the WinWord window so that the program does not take up the entire screen. You will then be able to click on another application window and activate it to perform some other task while WinWord is printing in the background.

The Options menu in the Windows Print Manager lets you set printing priority to Low, Medium, or High. If you pick Low or Medium, Windows will give more processor time to WinWord, letting the program hand off the information to Print Manager much faster.

Make sure that the TEMP variable is pointing to a valid subdirectory (usually the \WINDOWS\TEMP directory) on a disk with at least 2MB of free disk space. The directory should be defined in your AUTOEXEC.BAT file with the following line

```
SET TEMP=d:\path
```

where *d* and *path* are the drive and path of your TEMP directory. If you have enough RAM in your system, you can increase the print speed by setting up a RAM disk of 2MB or more and setting the TEMP directory to point to the RAM disk.

Finally, when you're printing multiple copies of the same document with WinWord 2.0, make sure the Collate Copies check box at the bottom of the Print dialog box is deselected. This will tell WinWord to send each page to the printer once, along with instructions to print multiple copies.

Kate Edson
Mercer Island, Washington

▶PC MAGAZINE Most of these suggestions apply to any Windows word processor, not just WinWord, so I'll expand the discussion to include WordPerfect for Windows and Ami Pro as well. I'll also try to put these tips into wider perspective.

Print speed can be measured either by how fast you get printouts or by how fast you regain control of your system.

First, it's important to understand that you should treat the comments here as suggestions for things to experiment with. There are few definitive statements you can make about printing that will apply to every computer system—partly because the effectiveness of some of these tips will depend on things such as the speed of your hard disk, and partly because of differences in printers and printer drivers.

For example, if you have a printer with 4MB of on-board RAM to serve as a memory buffer, it can accept everything the computer sends at top speed. In such a case you might want to disable Print Manager altogether, as I'll discuss in a moment. On the other hand, if you have a slow printer with little or no buffer, the printer itself will be a bottleneck; the printer's speed will be the factor that determines how fast you can regain control of your system, and you will almost certainly prefer to use Print Manager.

It's also important to make a distinction between print speed as measured by how fast paper comes out of the printer and print speed as measured by how fast you regain control of your system. If your goal is to produce printed output as quickly as possible, you'll want different settings than if you want to regain control quickly and you don't care how long the actual printing takes. Here again, you'll want to experiment to find a comfortable compromise between the two extremes.

FASTER PRINTOUTS The fastest way to get printed output is to bypass Print Manager altogether. Go to the Windows Control Panel, choose Printers to open the Printers dialog box, and then make sure that the Use Print Manager check box is deselected. Your word processor (and other Windows programs) will now send output directly to the printer without taking time to spool the output to your disk first.

Ami Pro 2.0 users may also want to turn off Ami Pro's own background printing feature, AmiPrint. To turn off the feature, choose Tools, User Setup, then Options, and make sure the Print in background check box is deselected.

How much effect Print Manager has on the printing speed depends on your system. In general, the faster your hard disk, the less Print Manager will slow down your printing. On my tests with all three programs, on a 486/25 system with an appropriately fast hard disk (its average access time is under 20 milliseconds),

I found that the actual print speed for any given file changed relatively little with Print Manager off or with Print Manager on and set to Low, Medium, or High Priority. Similarly, turning off the AmiPrint feature in Ami Pro made little difference.

In contrast, when I set the TEMP variable to point to a floppy disk, print times nearly doubled when Print Manager was active, reflecting the additional time needed to spool to the floppy. The difference won't be as dramatic with even a slow hard disk, but it can be significant.

REGAINING CONTROL Even if sending output directly to your printer makes a tremendous difference on your system, you may be less concerned with print speed than with how quickly you get control back. As Ms. Edson points out, if you set the window to less than full-screen before printing, you can immediately click on another window to work on some other task. If you've forgotten to set the window to less than full screen, however, you can still move to another program. Simply press Ctrl-Esc to bring up the Task List, then switch to another program or Program Manager; or you can hold down the Alt key and press the Tab key repeatedly to cycle through the choices of currently open windows.

If you use ATM or FaceLift, you should know that bypassing Windows drivers also bypasses these utilities—and any fonts they provide.

Also note that with Ami Pro 2.0 and WinWord 2.0 (but not WordPerfect for Windows or WinWord 1.*x*), you can open another copy of your word processor and work on a different document while the first copy of the program is busy printing. (With WinWord 2.0 you must have SHARE loaded if you want to run two copies of the program.)

Even better than being able to move to another window is getting control back in the window you're printing from. With WinWord, you'll find a significant difference if you use Print Manager set to Low Priority. On my system, printing a ten-page file to a PostScript printer without Print Manager tied up WinWord 2.0 for 1 minute, 16 seconds. Using Print Manager set to High Priority saved about 2.5 seconds. Setting Print Manager to Low Priority saved a full minute, freeing up WinWord in about 15.5 seconds.

The priority setting for Print Manager didn't make much difference on my tests with Ami Pro 2.0. But turning on Ami Pro's background printing feature made a dramatic difference. With a ten-page file, Ami Pro was tied up for 2 minutes, 19 seconds with background printing off, but only about 5 seconds with background printing on. The time was about the same whether Print Manager was active or not.

WORDPERFECT FOR WINDOWS The situation with WordPerfect for Windows is a bit more complicated, because you can use either the standard Windows printer drivers or the drivers that are provided with WordPerfect. Print Manager didn't make any difference on my tests using the Windows drivers and printing files that contained only text, however, it made a significant difference when using the WordPerfect drivers. It also made a difference with the Windows drivers when printing files that included graphics.

WordPerfect Corp. claims that the WordPerfect drivers will print faster than the Windows drivers. On my tests using a PostScript printer and text-only files, both drivers delivered printed output at roughly the same speed. There was, however, a considerable difference in how quickly the two drivers returned control of my machine when using Print Manager: just over 12 seconds for the WordPerfect driver versus 1 minute, 10 seconds for the Windows driver. These results were essentially identical at either High or Low Priority.

The results were notably different for files that included graphics. With Print Manager active, the Windows driver produced printed output faster (1 minute, 34 seconds versus 2 minutes) and returned control slightly faster as well (10 seconds versus about 12 seconds).

If you're a WordPerfect for Windows user, you'll want to experiment with various combinations of drivers, Print Manager settings, and file contents to see what works best for whatever you consider a typical file. To change drivers, choose File, Select Printer, and use the option buttons at the bottom of the dialog box to switch between the list of WordPerfect drivers and Windows drivers. Then select a printer from the appropriate list. If you use Adobe Type Manager or Bitstream's FaceLift, you should be aware that bypassing the Windows drivers also bypasses these utilities—and any fonts they provide. (And please note that this discussion is otherwise ignoring font managers, though they add yet another variable that affects print speed.)

In any situation where you're spooling a print job to disk, setting the TEMP variable correctly can make a difference both in the speed and in the time needed to finish spooling. And since accessing RAM is faster than accessing a hard disk, setting up a RAM disk will always give you a speed advantage. (Chapter 14 of the Windows 3.1 users' guide, or chapter 13 in the guide for Version 3.0) explains how to set up a RAM disk using RAMDrive.) Note that if you don't have enough RAM available to spare 2MB for a RAM disk, but you do have more than one hard disk, you should make sure that the TEMP variable points to the fastest hard disk.

MULTIPLE COPIES The last suggestion in Ms. Edson's list—about letting the printer rather than WinWord print multiple copies—applies only to laser and other page printers. The Collate Copies check box will be grayed out if you have an inappropriate printer selected.

The advantage of letting the printer handle multiple copies is that when you do this, WinWord sends each page to the printer just once. After the image is formed at the printer, the printer cranks out as many copies as needed. If you choose Collate Copies, the program will continue to resend the entire document (or range of pages) to the printer as many times as necessary. The obvious disadvantage of letting the printer handle multiple copies is that you then have to spend time collating copies.

In general, if a document includes graphics or heavily formatted text, you'll probably save time by letting the printer handle the multiple copies. If the docu-

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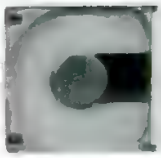

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ment consists of single-column Courier text, you'll probably save time by letting WinWord print the document multiple times, even though the printing will take a little longer.

If you are using WinWord 1.x, you won't find a Collate Copies check box; collating is built into the program. But you can still hand multiple copies over to the printer by changing the setting in the printer driver. You can do this within WinWord by choosing File, Print Setup, then pressing the Setup button, setting the number of copies, and then pressing OK twice to close the dialog boxes. Then print as usual, with WinWord set to print one copy. Be sure to reset the driver for one copy when you're done.

Ami Pro 2.0 users will find a Collate check box if they choose the Options button from the Print dialog box. But when Ami Pro is not set to collate, it doesn't hand the task of printing multiple copies over to the printer. Rather, Ami Pro itself will print each page repeatedly. To have the printer handle the multiple copies, you have to set the proper number of copies in both Ami Pro and the printer driver.

To set the printer driver from Ami Pro, choose Setup from the Print dialog box, set the number of copies, and choose OK. Then set the number of copies in Ami Pro's Print dialog box as well. Be sure to reset the driver to one copy when you're done.

WordPerfect for Windows users will find a choice in the Print dialog box for generating multiple copies by Printer or by WordPerfect. The feature, however, may not work reliably. On my tests, it worked properly when WordPerfect was installed to use the WordPerfect PostScript driver. But with WordPerfect set to use the Windows PostScript driver, the program printed multiple copies in collated order, regardless of the setting for producing multiple copies. WordPerfect Corp. says that this is a known problem, and that it shows up with other printer drivers as well.

If you run into this problem, you can still get the printer to print the multiple copies by setting the Windows PostScript driver for multiple copies, much as with Ami Pro. Choose File, Select Printer, then select the Windows PostScript driver, choose Setup, and then set the number of copies in the driver's setup dialog box. Note that you have to set the number of copies in both the driver and the Print dialog box, as with Ami Pro. Make sure you don't forget to change the Copies setting in the driver back to one copy when you're done. □

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CIRCLE 309 ON READER SERVICE CARD

CONNECTIVITY

Backing Up on a Network: Choosing and using a network backup system Virus Protection On-Line: Protecting your system from and curing it of viruses.

BY FRANK J. DERFLER, JR.

Moving Nine-Track Tape Data

We have a room full of tape reels that were recorded from an IBM mainframe at 1,600 bits per inch. We no longer have the mainframe, but we'd like to get at some of the data files. How can I read these tapes on a PC?

John Freeland
Los Angeles, California

▶**PC MAGAZINE** This is a perennial question that becomes more important as time passes and organizations lose the capability to read old data. Computer Logics Limited (216-349-8600) has an excellent nine-track tape system for PCs. The company provides the adapter, cable, and software needed to attach to a tape drive using the common Pertec interface. You'll appreciate its ReelView software, which gives you the power—using wildcard- and Boolean-search operators—to find specific data within a record.

The kit sells for $895 with an 8-bit adapter that can achieve throughput of about 22MB per minute on a fast PC. For $1,295 you get a 16-bit board with a 1MB cache that can move 43MB of data from a tape in 1 minute.

While they go way back, these nine-track tape systems aren't obsolete. They still provide a valuable way to move a lot of data between IBM or DEC minicomputers and PCs.

Setting Up for Private Calling

Do you know of a program that can be set up so that voice calls are handled by an answering machine but anyone wanting to connect to the computer can dial in, ring once, then call back (within a certain time) and be connected? I'm open to any suggestions, but I'd like the software to do the work in order to avoid buying an external "black box."

Steve Burke
via CompuServe

▶**PC MAGAZINE** I don't know of a canned program that will do this, but you can use the scripting language of any of the major communications programs such as Crosstalk Mk. 4, Smartcom, or Procomm to create a script with these capabilities.

Since, in verbose mode, the modem will send RING to the computer each time the line rings, you can create a script that counts the number of rings received within a certain period. Crosstalk's programming language has a built-in command to check system time, making the task easy. If the script sees more than one RING it drops off, but if it detects only one, it sends the auto-answer command to the modem. Many communications software companies maintain forums on CompuServe where you can get help with the programming details.

Backing Up on a Network

We plan to expand our network from its present three nodes to at least a dozen. I'm wondering, though, about where to put the tape backup system. We back up our present peer-to-peer network with a tape drive built into the server. Will this continue to work when we add more stations? What kind of storage device will we need to back up a busier server?

Jack Perry
Birmingham, Alabama

▶**PC MAGAZINE** Choosing a network backup system involves answering two questions: What kind of backup device do you want, and where do you want it?

The most common tape backup systems for PCs use the DC-2000—a small tape cartridge with a storage capacity of up to 250MB if the software uses data compression. These systems are available as an option on many PCs and they can connect to the floppy disk controller, making them low-cost solutions.

The QIC (quarter-inch cartridge) series of tapes has been around since the early 1980s. The old QIC-150 format provides capacities of up to 250MB without compression at a transfer rate of about 6MB per minute, depending on the PC. An excellent choice today is the QIC-525 tape system, which offers up to 525MB of storage without compression. These drives move data at 12MB per minute and have hardware error detection that was missing in the earlier products. QIC tape systems are now available with capacities of up to 1GB (gigabyte) and transfer rates from 18MB to 36MB per minute. This standard will grow to capacities of over 10GB in the next few years.

The QIC drives have competition from the digital audio tape (DAT) products that can pack up to 2GB of data into a very small cartridge. Make sure any DAT system you consider uses the Digital Data Storage (DDS) format, which includes the heavy-duty error control needed when data is packed so tightly on the tape. DAT products usually cost more than QIC-525 products, but they offer more room for growth. If you can afford it, I recommend a DAT DDS drive.

At the high end of the spectrum are drives produced by Exabyte and sold by several firms. These drives use 8-mm videotape cartridges to store up to 5GB at transfer rates of 30MB per minute.

Don't overlook the option of backing

up data to removable Syquest or Bernoulli drives. Some removable drives offer capacities ranging from 40MB to 80MB with typical data rates of 4MB per second. If you back up only those data files that have changed since the previous backup, you may not need a lot of storage. Remember, you only need to back up the operating system and most applications once. Many people who do CAD or desktop publishing work find it easy to store the images from specific projects on removable drives.

The typical model for network backup is to put the backup device on one client PC and then back up the drives from all the servers over the network. It is true that if you integrate the drive into the server, either under a DOS network operating system or special software for operating systems like NetWare, you avoid loading the network with the backup data and get faster throughput. But this can also slow down the overall operation of the server.

There's another technique you can use to back up all of the networked PCs from one client PC if you don't attach the drive directly to the server. Even if you are running a dedicated server product like NetWare or VINES, you can use a menu program on each client PC to load peer-to-peer networking software on each PC at a specific time (usually at night) when the PC and the network are idle. Each PC becomes a server to the single backup client. The scripted commands on the client PC back up the changed files on each PC in the network. People lose data on their local drives, too, so this technique ensures that you have a current backup of all drives, even those that aren't normally network servers.

You'll need backup software able to handle various types of drives, since you don't want to be stuck with software that is married to one particular kind of hardware. I like PowerSave from Performance Technology (512-349-2000) for network use. PowerSave works with almost any storage device and offers excellent flexibility.

The bottom line? Do a full backup every night of all the servers from a client PC. If your storage system can't handle this, you can get by backing up only the changed files—but at a cost of increased difficulty if you need to do a restoration.

Low-Cost Printer Sharing

We need to share a printer among three PCs in my office. I understand networks enough from reading your column to know that I don't need one, but I'm not sure what the best answer might be. What's the least expensive, most effective solution?

Sylva Dominis
Los Angeles, California

▶PC MAGAZINE Our April 30, 1991, issue presented a review of buffered printer-sharing devices that connect multiple PCs to multiple printers for less than $150 per node. If you need connections to only one printer you can use an even simpler solution such as the JetWay from ASP Computer Products. The $345 external device works with any printer and provides connections for up to four PCs. An eight-port version retails for $545. In many situations I've used ASP's ServerJet, which you place inside various models of HP LaserJet printers. It provides a simple way to share one printer among four users, but it fits only LaserJets.

In my experience, these ASP products are plug-and-play. You can call the company at 408-746-2965 for more information.

Virus Protection On-Line

Our computers were recently stricken with the Hong Kong virus, which caused us to spend a couple of days looking for hardware problems until we realized what was the actual culprit. I'd like to continue my activities on bulletin board systems, though, because I get many valuable utilities. How can I be sure that the BBS files are clean? Also, can something like the Hong Kong virus affect our NetWare server?

Miles Freeman
Boston, Massachusetts

▶PC MAGAZINE I haven't yet heard of a virus that attacks NetWare directly; it would literally have to run under NetWare as a NetWare Loadable Module (NLM) or a value-added process (VAP). Your network administrator should control physical access to the server to prevent anyone from loading a virus of this type. A virus certainly can spread between PCs across the network, though, as users load applications and copy files to and from the server.

Many companies, including Certus International Corp. (216-546-1500), Fifth Generation Systems (504-291-7221), and Xtree Company (805-541-0604), market antivirus software that actively checks files on the server. I couldn't sleep at night if I didn't have at least one of these products running on my network.

In the area of communications software, HyperAccess/5, marketed by Hilgraeve (313-243-0576), automatically searches for the signatures of over 300 different viruses during communications sessions. This means that HyperAccess/5 can provide extra protection against virus infection resulting from downloaded bulletin board files.

When we caught the Hong Kong virus (also known as the Azusa virus), the folks at Microcom (617-551-1000)—who market the potent Virex antivirus program—provided a cure. They recommended using an undocumented switch for FDISK in DOS 5.0: /MBR (FDISK /MBR is the full command). MBR stands for Master Boot Record.

It seems that FDISK checks a signature in the master boot record and aborts if it doesn't find what it's looking for—unless you start it with the /MBR switch. In that case it replaces or repairs the boot record. If a virus has infiltrated the working boot record, the /MBR switch should eradicate it. When the boot record is refreshed, the viral code is overwritten. FDISK is strong medicine, but it worked for us. □

NETWORK YOUR QUESTIONS

Connectivity gives you practical solutions to networking problems of all types. We'll pay $50 for any tip we print. Please submit your letter on-disk along with a printout. Then mail your contribution to Connectivity, *PC Magazine*, One Park Ave., New York, NY 10016. You may also contact Frank J. Derfler, Jr., via MCI Mail (MCI ID: 240-2931) or the LAN Labs fax machine (904-267-1578). We regret that we are unable to acknowledge submissions or answer letters individually.

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PC MagNet

Special Guests: A way to interact with the leading figures in the computer industry

BY JIM FREUND

Did you ever want to put a question to the CEO of the company that manufactured your computer or developed your favorite software package? PC MagNet provides interactive forums where you can rub virtual elbows with key industry leaders.

More often than not, these are people you'd have a hard time reaching on your own, yet they're in a position to answer your questions accurately or even have something done about the problem or issue you raise. Instead of speaking with a customer service representative, you can speak to the person who has the ultimate responsibility over the product you're interested in.

Not everyone asks questions; you may simply *lurk* (read the messages without otherwise participating). Usually *PC Magazine* writers and editors are stirring the pot, adding the acumen that industry analysts can lend to a discussion. The result is a dialogue among users, pundits, and industry leaders that gives you a view unavailable in other media.

You can also compare notes from guest to guest. Compare these electronic conversations, the first one with Borland CEO Philippe Kahn, and the second with Microsoft Executive Vice President Mike Maples:

Fm: Brian Moura 76702,1337 16-Feb-92
To: Philippe Kahn [Borland] 72241,522

Using the same forms, reports, etc., across Borland's Windows apps is a pretty shrewd approach. As I understand it, this would save the user from having to reinstall these modules/code once on the hard disk as other Borland apps are added. Does this mean we should have richer form, database, and report tools across the Borland Windows product line than others?

Fm: Philippe Kahn [Borland] 72241,522
16-Feb-92
To: Brian Moura 76702,1337

This means that you have "Familiar Objects" shared and you can use a Paradox Query in Quattro Pro, and a dBASE form in Paradox. The idea is not to save disk space, it's to share components and not have to reinvent the wheel every time. It's a very deep level of integration.

Fm: Michael Miller [PC Mag] 72241,352
11-Apr-92
To: Mike Maples [MSoft] 72241,732

How many Wizards would you like to see, eventually? Could other companies (such as vertical market software guys) create software Wizards that attach to MS products?

Fm: William Beem 75140,760 11-Apr-92
To: Michael Miller[PC Mag] 72241,352

Can you define "Wizards" for me? I'm not up on this one.

Fm: Mike Maples [MSoft] 72241,732
12-Apr-92
To: William Beem 75140,760

The term refers to a capability in an application to relate user task to program function.

For example, the calendar Wizard in Publisher asks questions like: monthly, daily, weekly? What border style (examples shown)? What language? And so on. The newsletter Wizard might ask how many columns you want in a document, type of title, etc.

Fm: Mike Maples [MSoft] 72241,732
12-Apr-92
To: Michael Miller[PC Mag] 72241,352

We have plans to make adding Wizards a generalized capability available to everyone. What a Wizard really does is take a task view of a problem (asking the user about the task to be performed) and outputs to the program the functions necessary to do the tailored task.

Therefore I would expect many Wizards from many sources.

And yes, many will be vertical.

This gives you a preview of the direction these companies' products will take in the future, which will help you make an informed decision when you purchase applications.

Many on-line services have an hour or two in which a celebrity may appear. Although PC MagNet has virtual conference rooms at its disposal, we've decided to do this a different way to allow for more in-depth conversation and better interaction between participants. We invite the guest for a few days and devote a section in one of our forums to that person. Users are not limited to one question, and they're not under the time constraint of that transient moment the guest is available in a conference. Take your time to consider what you want to say. There's less opportunity for *esprit de l'escalier*—when you realize what you wanted to say only after the fact.

When the session is over, an archive of the complete discussion threads is created and made available to everyone. Our Editorial Forum's Library 9 (Special Guests) has recent discussions with Michael Dell (of Dell Computer Corp.), Philippe Kahn, and Mike Maples available for downloading.

You can expect to see many more guests, panels, focus groups, and events on ZiffNet, so be sure to read "Today on ZiffNet" and look for news flashes when you enter forums. □

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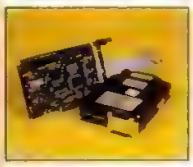

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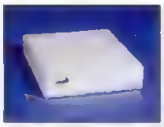

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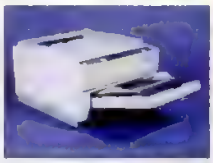

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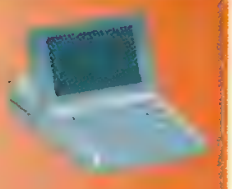

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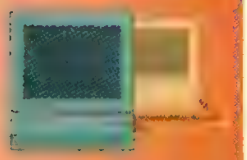

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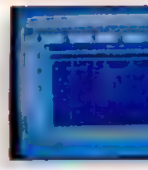

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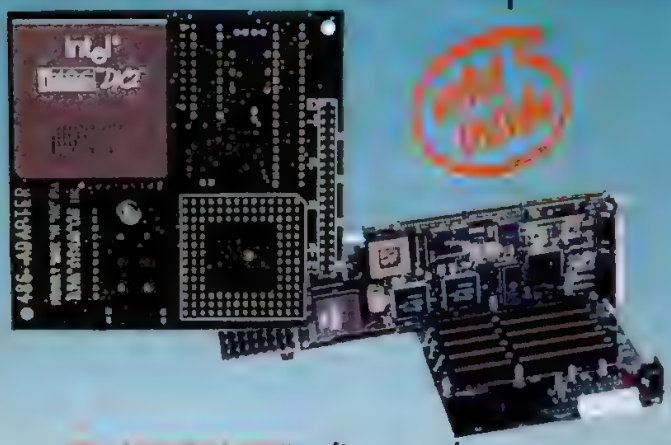

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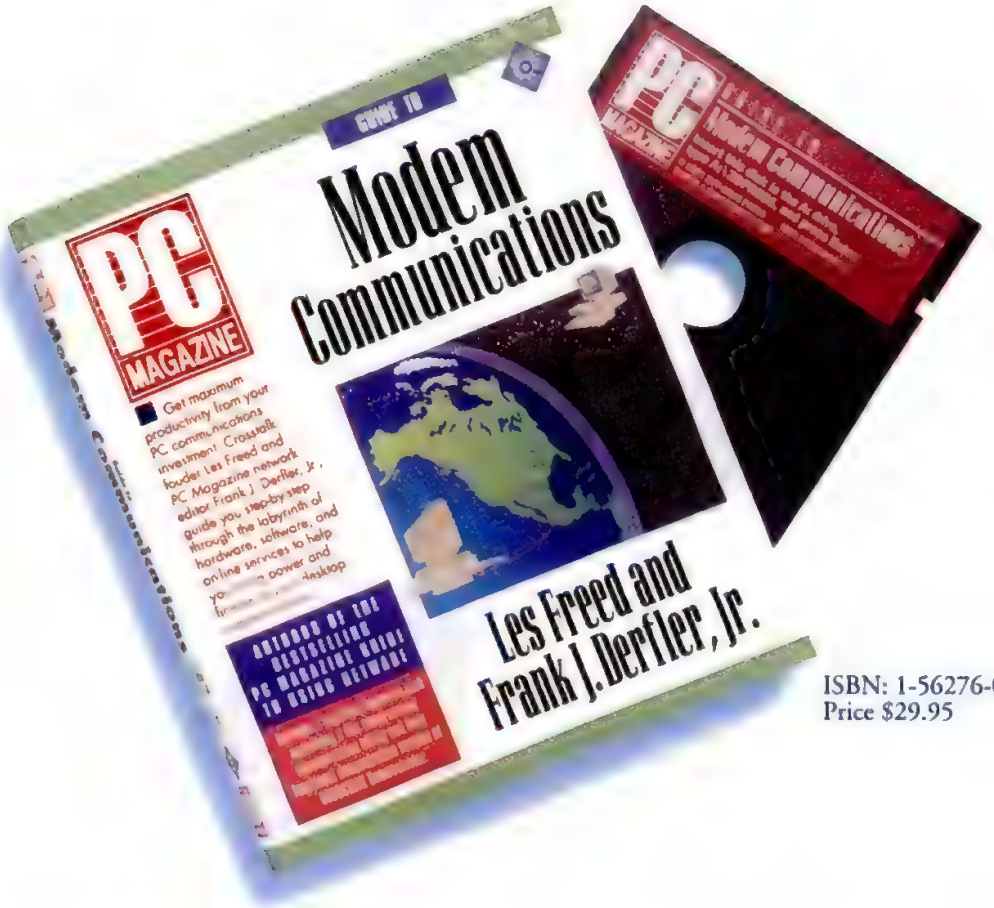

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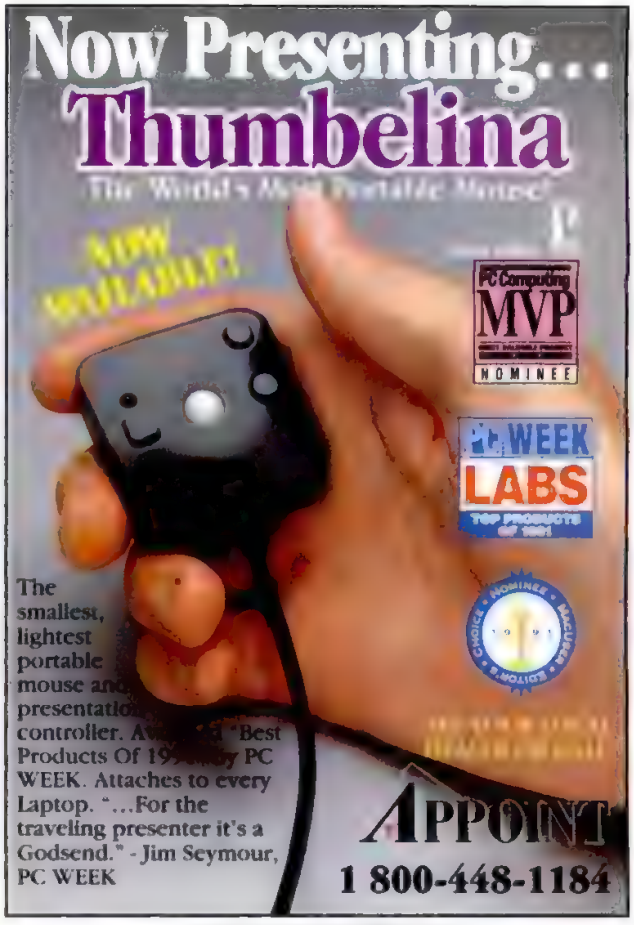

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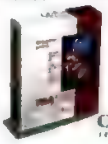

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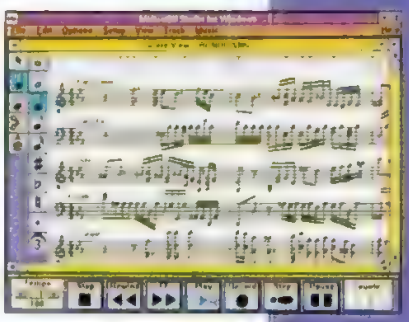

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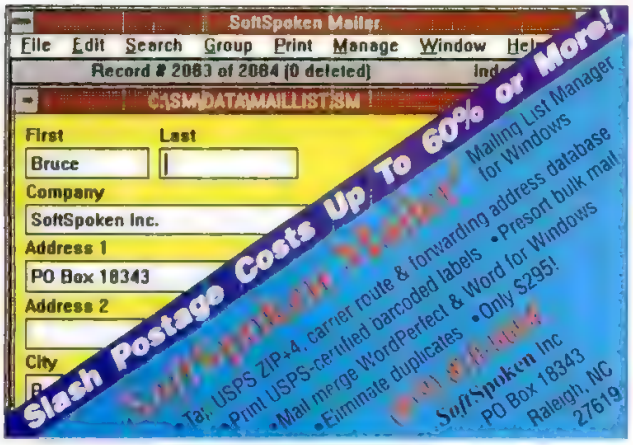

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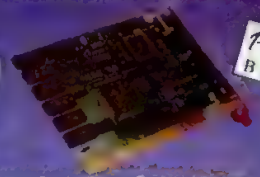

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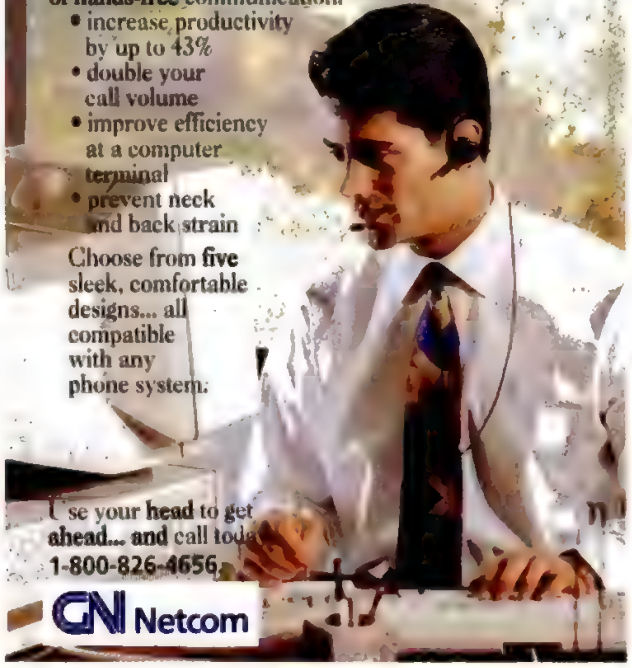

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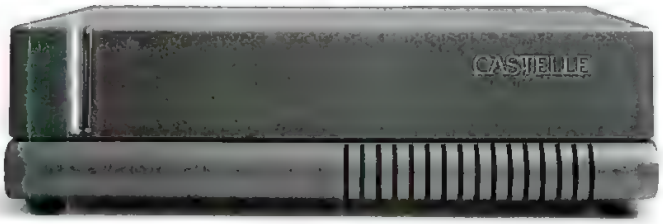

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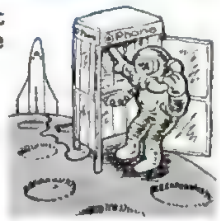

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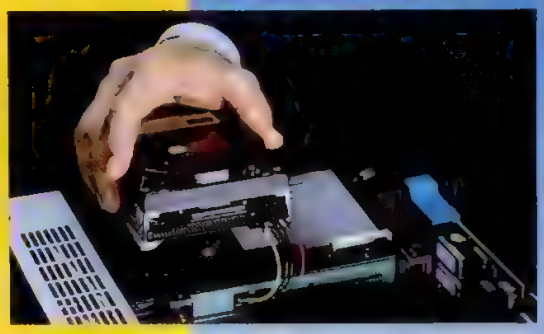

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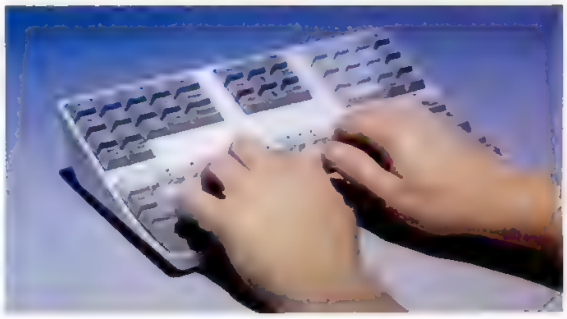

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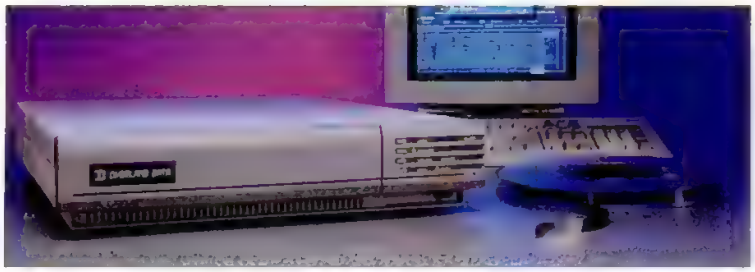

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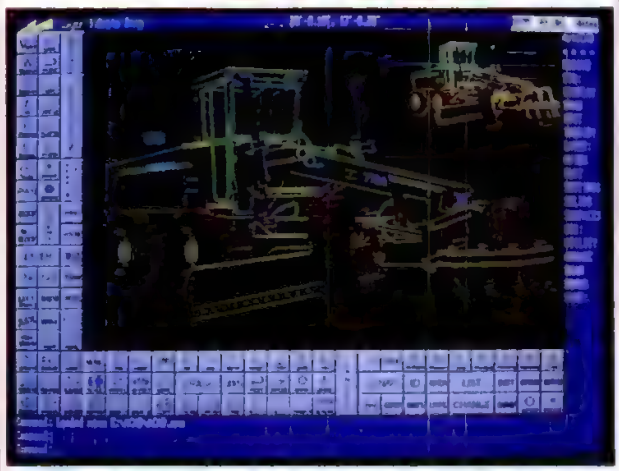

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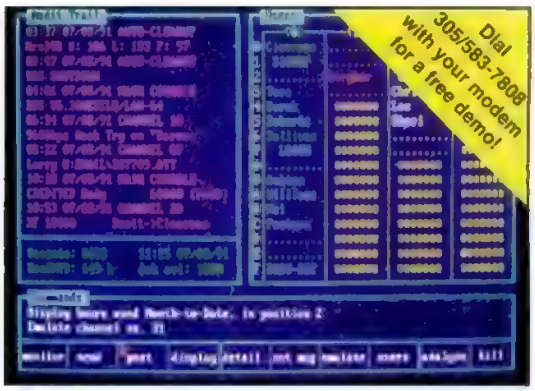

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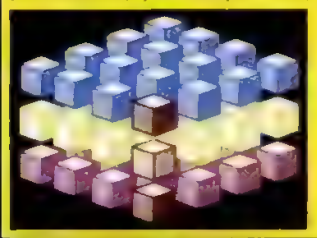

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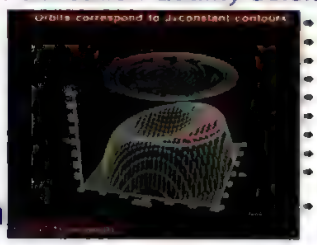

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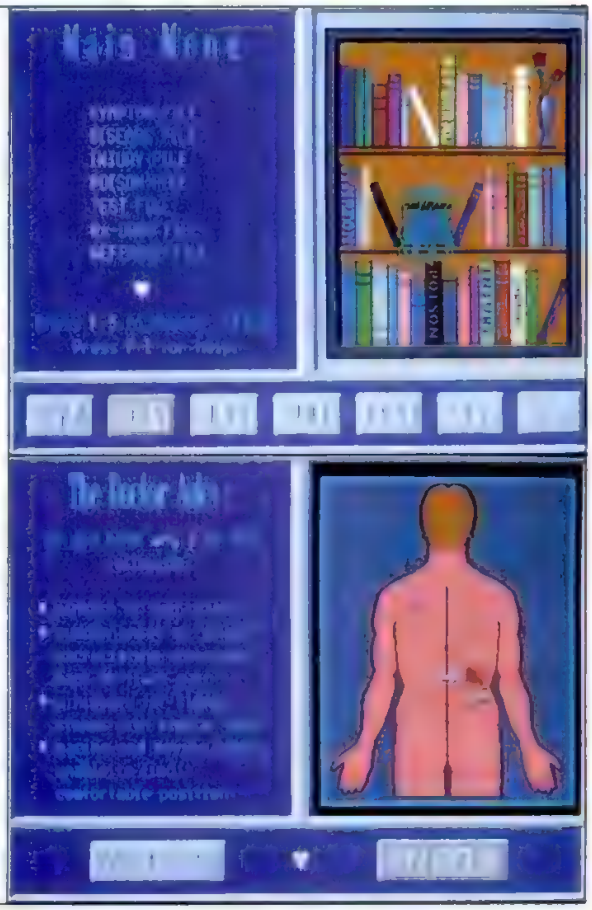

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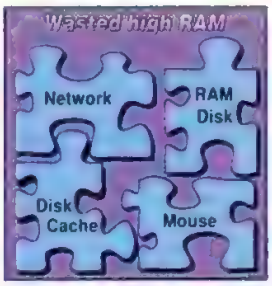

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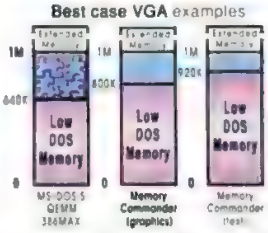

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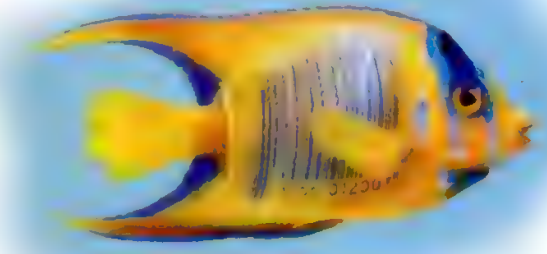

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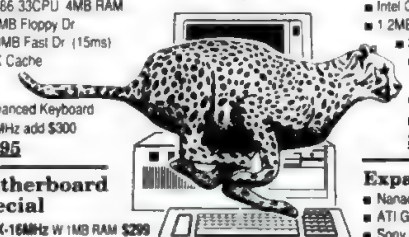

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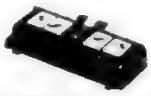

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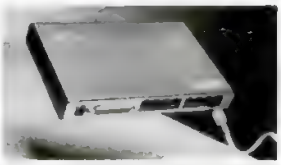

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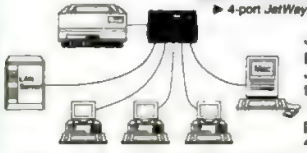

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697	698	699	700	701	702	703	704	705	706	707	
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1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	
1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	

040	041	042	043	044	045	046	047	048	049	050	
087	088	089	090	091	092	093	094	095	096	097	
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234	235	236	237	238	239	240	241	242	243

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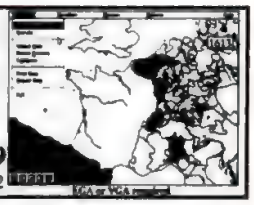

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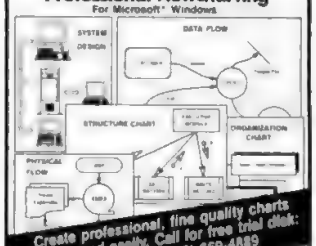

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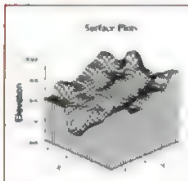

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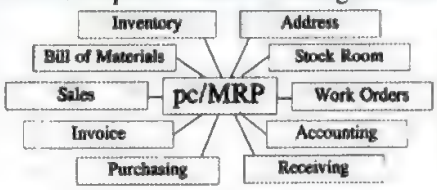

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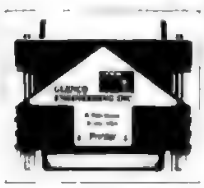

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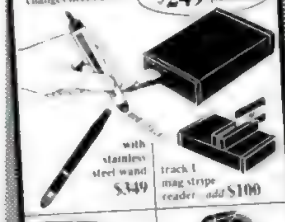

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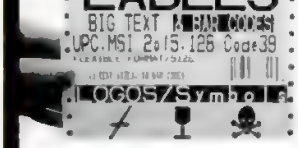

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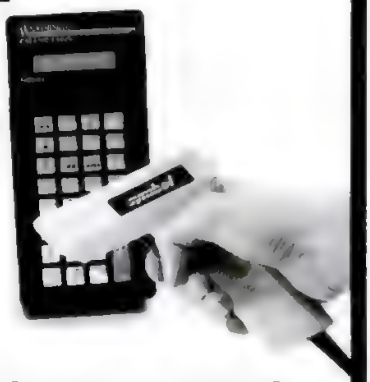

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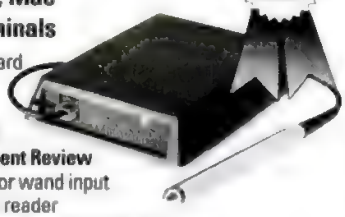

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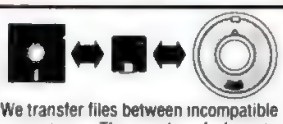

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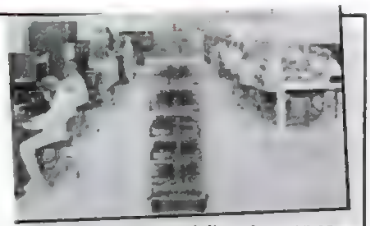

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Coming Up

Notebook and Color Portable PCs

PC Magazine Labs tests 80 state-of-the-art portable PCs including the latest notebook systems from Compaq, Dell, and Gateway 2000. In all, you'll see 66 386 and 486 notebook systems, 13 color portables, including entries from NEC, Toshiba, and IBM, and take a look at Apple's Mac PowerBook 170.

Networking/Communications

V.32 modems have gone on the road. With rates of 9.6 kilobits per second, these portable modems offer high-speed connection to the office, the home, and your favorite electronic mail service. PC Magazine Labs tests both internal and external modems for laptops. But do they really stack up against their desktop counterparts?

Portable Printers

Laptop computers are great up to a point—but what if you need a hard copy while on the road? *PC Magazine* looks at seven of the latest portable printers from companies such as Brother International, Canon USA, Citizen America, and Eastman Kodak. We'll let you know which gives the cleanest output with the least amount of fuss—and weight.

2-D Animation

As multimedia moves into the mainstream, more and more businesses will look to add flash and dazzle to their presentations in the form of moving images. We test seven 2-D animation packages aimed at the serious business user and—at under $1,000—anyone who's interested in exploring the emerging world of PC animation.

Integrated Software

Limited by your laptop's hard disk space? Check out *PC Magazine*'s review of eight low-cost integrated software packages, including our August 1991 Editors' Choice winners, Framework XE 1.0 and Microsoft Works 2.0, and this year's new challengers, LotusWorks 3.0 and WordPerfect Works 1.0. Perfect for laptops, integrated software makes one neat package.

Utilities

Don't you wish the Windows Clipboard could hold more than one item at a time? CLIPSTAC, next issue's utility, does just that. Designed for both Windows 3.0 and 3.1, CLIPSTAC creates a stack, or history list, of text and bitmapped images that you can copy to the Clipboard with any program. It stores these in a file and then lets you copy them back to the Clipboard by selecting them from a list box.

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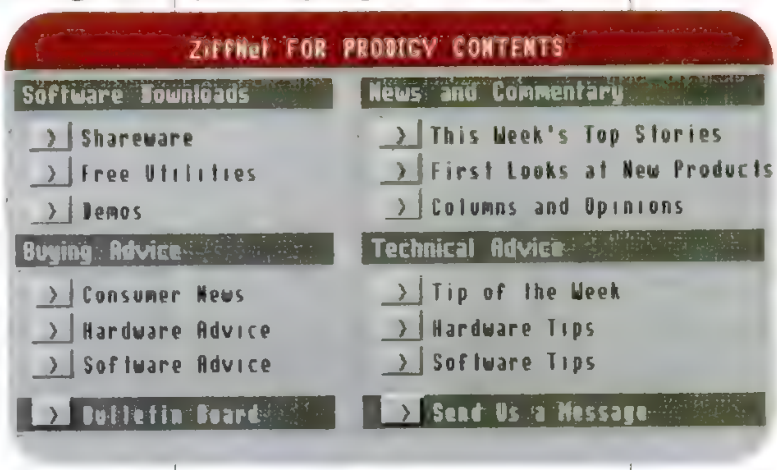

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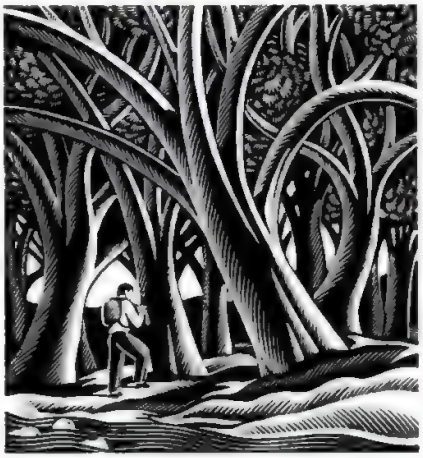

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After Hours

STRATEGY: *Five chess packages challenge the grand masters*
ENTERTAINMENT: *SimAnt lets you rule your backyard; you're the hero in The Rocketeer*

STRATEGY

3-D Animation and Strong Play: Five Chess Packages Do It All

BY BARRY BRENESAL

Ever since MANIAC won the first computerized chess game against a human in 1956, programmers have vied with one another to produce the most powerful chess game, one able to outwit even grand masters consistently. But individual software manufacturers have had a more modest goal: To make the one chess program that you will enjoy best—and buy.

Chess programs on the whole have become advanced enough to change the focus from mere playing strength to animation, elaborate two- and three-dimensional graphics, in-depth tutorials, and chess raters that determine your playing level; these have become the weapons on the field of battle.

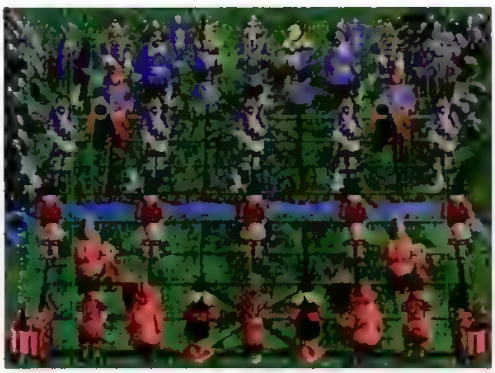
We have chosen five chess programs for this roundup: Interplay Productions' Battle Chess, Battle Chess II: Chinese Chess, and Battle Chess for MPC; Software Toolworks' The Chessmaster 3000; and Activision's Sargon V. Chessmaster 3000 is the best of the group, but each package can hold its own against even the strongest chess players.

BATTLE CHESS

The allure of the Battle Chess series is easy to understand: It's the only animated chess game available. Pieces walk across the board, indulging in slapstick worthy of Monty Python when a capture takes place. Bishops use their miters like jousting staves; the kings toss bombs. (If a pawn hitting someone over the head with a sword stops being uproariously funny, you can also play the game in its more staid, nonanimated 2-D mode.)

You should pass on the original PC-based Battle Chess. Its low-resolution CGA, EGA, and VGA graphics are difficult to see, and it lacks help screens and hotkey menu shortcuts. Nor does the game provide tournament, championship, or blindfold options. It also has no print or notetaking utilities and can't import or export move lists or board positions. Battle Chess II: Chinese Chess and Battle Chess for MPC are better alternatives.

Battle Chess II is an oriental variant of the game, as its subtitle, Chinese Chess, suggests. While chess evolved in one direction after traveling the medieval trade routes to Europe, the version that remained in the Far East took a different turn. Moves take place on corners, rather than within squares; pieces only partially resemble their Western counterparts. Counselors move diagonally, like bishops, for instance, but within a four-square radius of the back row (called the Imperial Palace). Pawns move forward one square at a time until each crosses "the Yellow River," which divides the warring opponents. Then the pawns can move left or right as well.



The original Battle Chess and the multimedia Battle Chess for MPC are best known for their Monty Python–like animation. Battle Chess II (below) adds a Chinese flair.

Battle Chess II's VGA mode is low-res but more appealing than its Battle Chess counterpart. The package supports a variety of sound boards, and plays attractive, Far Eastern–sounding melodies; the digitized special effects, though, are annoying. Both PC-based Battle Chess programs feature relatively slow computerized players, partly because they have somewhat small libraries of opening moves. (Battle Chess offers 30,000, compared with Chessmaster 3000's 150,000.) For faster play, allocate more buffers and disable caching.

Battle Chess II's animation is good, but the humor is obvious and ages quickly; the 2-D alternative features attractive Chinese symbols.

Battle Chess for MPC adds the dimensions of multimedia to the original Battle Chess. It is most notable for its 30-minute animated tutorial, one of the best and most imaginative yet devised. Each chess piece comes forward to describe its personal history and current capabilities.

As you'd expect from the Windows environment, the screens offer an extremely attractive 256 colors in high-resolution VGA (640 by 480) mode. The animation, with more than 100MB of graphics, is delightful. It's a pity Interplay scrimped on documentation, though. Only one information card updates the standard Battle Chess material, which is also enclosed, and the outer sleeve makes no mention of the tutorial.

The factors that limit PC-based Battle Chess also apply to Battle Chess for MPC: no file import or export and no

printing or notetaking, for example. It is the only multimedia chess program available, however. If you know someone who's dazzled by the hi-tech values of television and the movies, the tutorial is mandatory.

Battle Chess, *$49.95*; **Battle Chess II: Chinese Chess,** *$49.95*
Requires: *512K RAM, DOS 2.1 or later.*
Battle Chess for MPC, *$79.95*
Requires: *Multimedia PC with 3MB RAM, MPC-compatible CD-ROM drive, Microsoft Windows 3.0 or later with Multimedia Extensions. Interplay Productions, 3710 S. Susan, #100, Santa Ana, CA 92704; 800-969-4263, 714-549-2411.*
Circle 505 on reader service card

THE CHESSMASTER 3000

It isn't hard to be overwhelmed by The Chessmaster 3000. Available in both DOS and Windows versions, the program has chess-playing capabilities and features that are among the strongest available. You can import and export ASCII or Forsythe board positions and move lists. There are adjournment and replay options and an analysis mode that totals the strength of each side's moves relative to the other. The program offers quick, simple hints, and it provides annotated explanations for those suggestions.

Two illustrated beginners' tutorials come with Chessmaster 3000. One offers instructions on each piece and the other reviews sacrifices, double attacks, and similar strategies. A separate chess rater presents you with 30 problems and gives you an approximate rating based on United States Chess Federation rules.

Chessmaster 3000 provides several 2-D and 3-D chess sets (in low-res VGA or hi-res EGA), but also a special War Room mode. This mode includes a 2-D board, an abbreviated list of recent moves, captured pieces, and a display of the computer's current line of thought.

Like all the other chess programs in this review, Chessmaster 3000 uses a mouse, but it also accepts a range of notation-entry styles to direct movement: algebraic (e4), descriptive (P-K4), coordinate (e2-e4), and correspondence (5254).

One of the program's best features is its computerized playing styles. Many are named for chess grand masters from the past, such as Lasker, Capablanca, Nimzovich, and Tal, though some have more generic designations like Woodpusher, Pawngrabber, and Kamikaze. You can also design your own playing style. The styles aren't based upon any grand master's game; instead, they use a series of well-defined parameters that customize play. Your style can take into account such things as the point values of different pieces, book depth, and sliding measurements like material/positional and attacker/defender. You can also set a style to accept draws, and a "vision factor" simulates potential moves you overlooked.

Though Sargon V features fast play and a wide range of 2-D and 3-D board layouts, its illustrative and annotated modes confuse the player, rather than clarify the game.

Feature-rich Chessmaster 3000 includes a personality editing screen that lets you design and play against your own opponent.

Only Chessmaster 3000 furnishes material on the history of chess. The small but generous booklet is well-versed in chess matters but cavalier about other facts. (For instance, the "church in Russia"—presumably the Eastern Orthodox Church—did not make "a concerted and unsuccessful effort to discourage chess playing" in 1000 AD.)

Accessing features can be annoying if you don't have a mouse. Many commands have no keyboard equivalent, and it's hard to see the highlight around each radio button in the DOS version's handsome imitation-Windows interface. If you page down through the good online help (which, unfortunately, doesn't include a search function), the highlight bar vanishes from the screen. You have to click on a selection, or scroll through every entry to keep the highlight bar active.

Despite its limitations, Chessmaster 3000 is the most ambitious and successful PC-based chess program to date, with an opening library of 150,000 moves. It's faster than any PC-based competitor, with excellent EGA and VGA definition. Its options are extensive, the choice of styles among computer opponents amusing and innovative. This is currently the chess program to get, and the one for the others to beat.

The Chessmaster 3000, for DOS, *$49.95*
Requires: *640K RAM, DOS 3.0 or later.* **The Chessmaster 3000, for Windows,** *$59.95*
Requires: *Windows 3.0 or later. Software Toolworks, 60 Leveroni Ct., Novato, CA 94949; 800-234-3088, 415-883-3000.*
Circle 506 on reader service card

SARGON V

Sargon made its debut in 1978, but the latest revision bears little resemblance to that primitive original.

Sargon V and Chessmaster 3000 are alike in many ways, though Chessmaster is the better of the two. Both have hints, clocks, move lists, and large libraries of opening moves. Both offer three kinds of chess notation to track moves, tournament and blindfold modes, 2-D and 3-D alternative set and board designs, Windows-like pull-down menus with substitute hotkeys, and attractive low-res VGA and hi-res EGA. Each can use expanded memory. Only Sargon and Chessmaster 3000 "think"

during your turn, which speeds up their responses and improves their game.

Sargon also offers its own specialized features. Unfortunately, the ideas are good but often poorly executed. For example, Sargon uses music, but its four tunes sound alike and restart whenever you make a move. (The idea of programming a continuous 15-minute selection hasn't yet occurred to any developers.) A more entertaining feature is the small squirrel that bounds across the bottom of the playing screen, as if to say "Nuts!" when you commit a blunder.

Sargon's Annotated mode leads beginners through specific games, but its messages are often inscrutable. The comment, "Playable, but not the usual continuation," for example, explains nothing. Worse, after remarking, "The less-often observed Exchange Variation," Sargon undid my last move. I found this confusing rather than helpful.

The Illustrative mode offers a similar idea, poorly worked out. You take the roles of the winning players in a series of previously played grand master–caliber games, and try to guess each of the winner's moves. You get points for correct guesses. But in any game, many potential lines of strategy are correct, and you would have to know the entire game in advance to guess each move successfully.

Extra features notwithstanding, Sargon is runner-up to Chessmaster 3000 in this competition.

Sargon V, *$49.95*
Requires: *512K RAM, DOS 2.1 or later. Activision, P.O. Box 67001, Los Angeles, CA 90049; 310-207-4500.*
Circle 507 on reader service card

ENTERTAINMENT

SimAnt: Rule the World (Actually, Your Backyard) with Maxis's Latest Simulation

BY GAYLE EHRENMAN

Where SimCity lets you play city planner and SimEarth lets you play God, SimAnt: The Electronic Ant Colony lets you play queen. Being queen is not all it's cracked up to be, though.

SimAnt puts you in charge of a colony of black ants. You must feed newly hatched ants, defend yourself against the red army colony, and protect the queen.

As its title suggests, SimAnt is an ant simulation game in the mold of its more far-reaching Sim-siblings. Here, you play the leader of a black ant colony, a nest of ambitious insects that plans to overrun a backyard and a suburban home, wiping out the rival red ants in the process. You must help your colony expand from a single nest to a house-ruling supercolony. You and your subjects dig tunnels, collect food, and breed, all while avoiding ant lions, lawn mowers, and humans. SimAnt offers a variety of views. Point and click with the mouse to watch your subjects in a cross-section view of the underground nest, to see the world on the surface (the ant's-eye view), or to gain a global perspective.

You can choose one of four modes: Tutorial, Quick Game, Full Game, and Experimental Game. Quick Game pits the black colony against the red colony in antenna-to-antenna combat. Full Game lets you start with one colony and begin your march across the suburbs. Experimental Game lets you add obstacles at whim.

Where this game differs from Maxis's previous Simulations is in its simplicity. You can play—and win—an entire game of SimAnt in about a day. You probably won't want to play more than once, though. Play is not that challenging, and it's hard to care about ants unless you're a budding entomologist.

You may, however, want to read the manual. It presents everything you ever wanted to know about ants, from their behavior to their medicinal uses, in an amusing fashion.

As an educational experience, SimAnt is a winner; as a game, it's disappointing. It's nowhere near as challenging or involving as its predecessors.

SimAnt: The Electronic Ant Colony, *$59.95*
Requires: *640K RAM, 2.5MB hard disk, DOS 3.3 or later; mouse recommended. Maxis, 2 Theatre Sq., #230, Orinda, CA 94563; 800-336-1947, 510-254-9700.*
Circle 503 on reader service card

GAMES

Be Your Own Comic Book Hero With Disney's Rocketeer

BY TIN ALBANO

Ever want to be a comic book hero? Well, now you have your chance. Novalogic has turned Walt Disney's lauded (if not lucrative) movie, *The Rocketeer,* into an adventure for your home PC.

You star in the lead role, as flying ace Cliff Secord. Your mission: To recover the secret of the Cirrus X-3 experimental rocket pack and use the pack to save the lovely Jenny Blake from the Nazis. The story unfolds through a myriad of electronic comic book pages.

Your adventure begins at Bigelow's Air Circus, where you are preparing to compete for the Bendix National Air Racing Trophy. First, you choose one of three pre-World War II fighter planes to fly in the air race. Don't worry: The Rocketeer is by no means a flight simulator. You don't have to wade through a 200-page manual or take any special computer flying lessons before you're ready to play. Instead, you have to rely solely on your hand-eye coordination, because The Rocketeer plays like a coin-operated video game.

Fly the different planes until you find one you're comfortable with. You'll notice that each of the planes is different. Choose the Gee Bee R-1 if you prefer quick acceleration and flexible lateral movement. The Caudron C-460, by comparison, is designed to give the flyer sheer power and speed. Whichever you choose, you must win your races before you get to fly the top-secret Cirrus X-3 rocket pack. The Nazis have stolen the secret of the Cirrus X-3 along with your girlfriend, so it's up to you to save Jenny and recover the confidential information before the Nazi commander returns to Germany.

DIGITIZED VIDEO

After you select your airplane and the air race begins, it becomes apparent that The Rocketeer is not your average PC game. This game uses the same video technique that Access Software's Links: The Challenge of Golf uses. That similarity speaks volumes, since Challenge won a *PC Magazine* Award for Technical Excellence. The makers of the The Rocketeer have digitized actual film video, giving your standard VGA display realistic depth and brilliant color. The cartoon-like figures appear to be superimposed on a real landscape, and this technique makes the game as much a pleasure to watch as it is to play. With a compatible audio card (such as a Sound Blaster), digital sound fills the room and the characters in the pages of the comic strip spring to life.

Each action scene in the story line is markedly different from the previous one. You fly fast airplanes, engage in arcade-like shootouts, and even have a fistfight against an evil Nazi as you struggle to save Jenny—and win the game. Some of the challenges are quite difficult. If you crash into a racing post or burn up in mid-air, however, you can return instantly to your favorite action sequence. Just enter a password at the beginning of a game, and you can choose where in the story line you want to be. Even if your kinesthetic ability is not quite up to par, the graphics alone make The Rocketeer a great game. □

The Rocketeer features arcade action sequences within the familiar Disney movie plot. Here, you fly the yellow Gee Bee R-1 at Bigelow's Air Circus.

The Rocketeer, *$49.95*
Requires: *640K RAM, DOS 3.2 or later; joystick recommended. Walt Disney Computer Software, 500 S. Buena Vista St., Burbank, CA 91521-6740; 800-688-1520, 818-841-3326.*

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Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Bill Howard

☞ **Plant Engineering magazine (February 8, 1992) has captured the world's most lifelike computer-controlled welding robot.**

Fig. 1. Fumes generated by robotic welding operations must be captured to protect the integrity of nearby auto-

Classified Intelligence: Let's Try Something Else Now that We're Tired of This Computer Fad

"Epsom prntr, good cond $75/obo. Apple computer, 2 dd, nds minor work, $150/will trade for aquarium xxx-xxxx"
—The Orange County (California) Register, March 15, 1992

"Will trade computer for Kirby Generation III sweeper xxx-xxxx"
—The Indianapolis Star, March 29, 1992

Maybe It's a Fiber-Glass?

"Fellowes Glass Monitor Filters—Workstation anti-glare filters increase your screen's contrast and reduce glare! Feature ultra-fine nylon mesh filter and adjustable mounting clip."
—CompuAdd Corp. catalog

☞ **When you consider how slowly the thing runs, maybe "Pest Scripts" isn't a bad description (Computer Palace newspaper ad, Los Angeles Times, March 14, 1992). Note also that the laser printer includes the laser (it should say "toner included"). Such a deal!**

You Mean That Big Red Switch on the Side? If It's An On/Off Switch, How Come It Says 0/1?

From the Getting Started chapter of the documentation for Fast Regs/OSHA software, OSHA-Soft, Amherst, New Hampshire (we are not making this up):

"**Step 1 . . . Turn Computer On**
If your computer is not already on, turn it on as you normally do. If you are unsure about how to turn the computer on, you may need to consult with someone more familiar with it."

☞ **This Staples office-supplies warehouse ad offers a Dell 320N+ notebook computer with a "nickel-metal hybrid batter."**
—The New York Times, March 10, 1992

We're Not Sure What the Word Means, but Just in Case, Don't Show this Ad to The Moral Majority

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—JDR Micro Devices ad, Computer Shopper, December 1991

If your entry is used in Abort, Retry, Fail? we'll send you $50 and a *PC Magazine* T-shirt. Caution: In case of multiple entries, the postmark date, neatness, and completeness of each entry are considered. Winners this issue: Wade P. Meyer (Robo-welder), Drew Boswell (step-by-step turn-on), Arnold Margolis (hybrid batter), Erin Lanway (copulous), Ayman Abumostafa (aquarium), Efton Park (Kirby Generation III sweeper), Bill Pinnell (mesh filler), Michael Yendrejczyk (Pest Scripts).

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WHEN ORDERING, PLEASE REFERENCE **#11BW6.** HOURS: 7AM-9PM CT MON-FRI, 8AM-4PM CT SAT, 10AM-3PM CT SUN. IN CANADA, CALL 800-668-3021. IN MEXICO, 95-800-010-0664.

Send for the brand new Dell product catalog, loaded with information on all our award-winning computers, service and support. Plus, get the details on our newest PCs, notebooks and servers. Return this card today, or call us at (800) 873-1130. In Canada, call (800) 668-3021. In Mexico, call 95-800-010-0664.

☐ Please have a Dell representative call me.

Name: (M) _____ (Please Print)
Title: _____
Company: _____ (If applicable)
Address: _____
City: _____ State: _____ Zip: _____
Type of Business: _____
Approx. # of employees in company: _____
Installed # of PCs in your company: _____
Home Phone: (_____) _____
Business Phone: (_____) _____
Fax Number: (_____) _____

1. Which products are you most interested in, and how many do you plan to purchase in the next 12 months?

Timeframe	i486	i486SX	i386	i386SX	Notebook	Other
Less than 1 month						
1-3 months						
3-6 months						
6-12 months						
More than 12 months						

2. If you resell, please identify your primary customers:
☐ Education ☐ General Business ☐ Government ☐ Medical

3. By which method do you acquire PCs?
☐ Mfg rep calls on me directly ☐ Local retailer
☐ VAR/Integrator ☐ Mail order/direct

4. From whom do you currently purchase PCs? _____

5. Are you interested in leasing? ( ) Yes ( ) No

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16 ISN'T SO SWEET ANYMORE.

These are the '90s.

Correspondence is more copious. Spreadsheets are more spacious. And networks have grown from novelties to necessities. 16 MHz just doesn't cut it anymore.

So we created the Dell 325SX. Its 25 MHz i386SX processor can run up to 40% faster than some of our competitors' comparable 16 MHz 386SX systems. And here's the best part: it costs up to $1,250 less.

Just think of it, 25 MHz for less than the price of 16. Is this a great country, or what?

Of course, you still get the same Dell service and support that's helped us win the *PC Week* Customer Satisfaction Poll an unprecedented eight times. With our toll-free technical hotlines and deskside service that can usually be there by the next business day.△

But giving people more for less is pretty much standard procedure here at Dell. It's made us an $890 million company, turned two-thirds of the FORTUNE 500 into customers and even moved us into the FORTUNE 500 ourselves.

So call and order a Dell 325SX today. Because it's not too often you run across a deal this sweet.

DELL™

800-545-1586

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Lease: $45/Mo.
The Dell 325SX i386SX, 25 MHz System.
System includes: 2MB RAM, 50 MB Hard Drive, and VGA Color Monitor.

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BRAIN SURGERY IT AIN'T.

Actual dealer price may vary.

LEASE◊:$127/MO.

It's simple. The Dell® 325NC costs up to $535 less than the Toshiba notebook.

The Dell notebook has a color display. The Toshiba notebook is black and white.

Our notebook has one year nationwide lapside service included in the system price. If needed, a technician will get to you usually by the next business day.△ (He'll either fix or replace the system and transfer the data if possible.)

Dell is one of the most awarded PC companies in the world.

Toshiba T3300SL	Dell 325NC
$4,034	$3,499
Black and White	Color VGA Display
i386™SL, 25 MHz	i386SL, 25 MHz
4 MB RAM, 80 MB HD	4 MB RAM, 80 MB HD
Battery life: 3 hours	Battery life: 3 hours
8.3" x 11.7" x 1.7"	8.5" x 11" x 2.3"
5.9 lbs w/battery	7.1 lbs w/battery
Return to dealer for service.	On-site lapside service.

†Source: Toshiba suggested retail price as of 5/5/92.

Over two-thirds of the FORTUNE 500® now buy from Dell.

Hmmmm. Give it some thought. Okay, that's enough. Now give us a call and order a Dell 325NC today.

DELL

800-545-1583

WHEN CALLING, PLEASE REFERENCE **#11BW2**.
HOURS: 7AM-9PM CT MON-FRI, 8AM-4PM CT SAT, 10AM-3PM CT SUN.
IN CANADA, CALL 800-668-3021. IN MEXICO, 95-800-010-0664.

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